

AN EXAMINATION OF
THE
THEORY OF EVOLUTION
AND
SOME OF ITS IMPLICATIONS.

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ON VETERINARY SCIENCE.

- A Manual of the Theory and Practice of Equine Medicine.** 10s. 6d. London: Baillière, Tindall and Cox, 1885.
- The Veterinary Pharmacology and Therapeutics, with an Index of Diseases and Remedies.** By JAMES BRODIE GRESSWELL, M.R.C.V.S. 5s. London: H. K. Lewis, Gower Street. 1885.
- The Equine Hospital Prescriber.** 2s. 6d. London: Baillière, Tindall and Cox. 1886.
- Diseases and Disorders of the Horse: a Treatise on Equine Medicine and Surgery.** (Dedicated by permission to The Right Honourable Lord Randolph Churchill.) 5s. London: Baillière, Tindall and Cox; *The Yorkshire Post*, Change Court, Albion Street, Leeds. 1886.
- The Veterinary Pharmacopœia, Materia Medica and Therapeutics.** By GEORGE GRESSWELL and CHARLES GRESSWELL, M.R.C.V.S., Nottingham. 10s. 6d. London: Baillière, Tindall and Cox. 1886. (Dedicated by permission to His Grace the Duke of Portland.)
- The Bovine Prescriber.** 2s. 6d. London: Baillière, Tindall and Cox. 1886.
- The Diseases and Disorders of the Ox.** London: Wm. H. Allen and Co., 13, Waterloo Place, Pall Mall, S.W. [Shortly.]
- The Diseases and Disorders of the Sheep.** [Shortly.]

ON THE EVOLUTION THEORY.

- The Wonderland of Evolution.** 3s. 6d. London: Field and Tuer. 1884.
- An Examination of the Theory of Evolution.** London: Williams and Norgate, 14, Henrietta Street, Covent Garden. 1888.
- Some Pathological Bearings of Darwinism.** 1s. By Dr. D. ASTLEY GRESSWELL, B.A., B.M., Christ Church, Oxford, M.R.C.S. London: Baillière, Tindall and Cox. 1886.

ON THEOLOGY, MUSIC, AND HUMAN MEDICINE.

- Analysis of Waterland on the Eucharist.** By the Rev. H. W. GRESSWELL, M.A., Hertford College, Oxford. 1s. London: James Nisbet and Co. 1886.
- How to Play the Fiddle; or Hints to Beginners on the Violin.** Second edition, revised and corrected. (Dedicated by permission to Dr. Joseph Joachim.) 1s. London: William Reeves, 185, Fleet Street, E.C. 1887.
- A Treatise on Human Therapeutics.** By Dr. ALBERT GRESSWELL, Physician, of Louth, Lincolnshire. (Dedicated by permission to Sir Henry Wentworth Acland, Regius Professor of Medicine in the University of Oxford.) [Shortly.]
- Diphtheria as a Chronic Malady.** By Dr. D. ASTLEY GRESSWELL. 1886.

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BY

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“Let our alliance be combined,
Our best friends made, and our best means stretch'd out ;
And let us presently go sit in council,
How covert matters may be best disclosed,
And open perils soonest answer'd.” SHAKESPEARE.

“For the credit of Virtue it must be admitted that the greatest evils which befall mankind are caused by their crimes.” LA ROCHEFOUCAULD.

“From Nature's constant or eccentric laws,
The thoughtful soul this general inference draws,
That an effect must pre-suppose a Cause :
And while she does her upward flight sustain,
Touching each link of the continued chain,
At length she is oblig'd and forc'd to see
A First, a Source, a Life, a Deity ;
That has for ever been, and must for ever be !” PRIOR.

“Does Fortune try thee ? She had cause to do't ;
She wish'd thee abstinent ; obey, be mute !” GOETHE.

“He that will often put Eternity and the World before him, and who will dare to look steadfastly at both of them, will find that the more often he contemplates them, the former will grow greater, and the latter less.” COLTON.

“As music made of rolling thunder,
That hurls through heaven its heart sublime,
Its heart of joy, in charging chime,
So ring the songs that round and under
Her temple surge and climb.” SWINBURNE.

To
THE RIGHT HONOURABLE
ARTHUR JAMES BALFOUR, M.P.,
CHIEF SECRETARY FOR IRELAND,

AS TO ONE, WHO, WITH A CLEAR VIEW TO THE
HONOUR AND WELL-BEING OF HIS COUNTRY, IS IN NO SMALL
MEASURE HELPING TO STEER THE STANCH VESSEL OF
THE UNITED KINGDOM
SAFELY PAST ALL THE REEFS AND SHOALS OF
TROUBLOUS AND DISTRESSFUL TIMES,
THE WORK WHICH FOLLOWS IS, BY GRACIOUS PERMISSION,
VERY RESPECTFULLY AND VERY GRATEFULLY
DEDICATED,
IN TOKEN OF ADMIRATION FOR
NOBLE AND HIGH-MINDED IDEALS OF CONDUCT,
BY
THE AUTHOR.

PREFACE.

THE following pages, such as they are, represent the results of a great deal of thinking. It is hoped that some success may have been achieved in an earnest endeavour to render the interesting, important, and intricate doctrine of evolution, as understood by modern writers, a little more simple, and on that account the more acceptable to the public mind.

It will be admitted, probably without any cavil, that to the greatest philosopher of this century, namely, to Mr. Herbert Spencer, the firm foothold which the hypothesis of evolution has gained is in chief part due. It is not too much to say that this deep and clear thinker has done more than any teacher of these times to modify in the right way human modes of thought, and therefore human actions. There are very few men who have made a name so highly celebrated during a lifetime, very few who have exerted such a widespread influence over contemporary beliefs, and it may be added that without doubt the verdict of posterity will be even still more favourable than that of the people of to-day.

Long may he live to control and direct men's minds, to speak words of wisdom and power to his fellow-pilgrims, wandering hither and thither, in their many and varied pursuits, for a brief time on this small portion of the universe!

It may readily be believed that one who brings himself to express views on this topic of evolution will probably be, in some measure, conversant with the writings of the greatest of all writers in this department of literature, and hence, if aught of good may be found in this little book, the author would willingly lay it in great part to the credit of that renowned philosopher whose works have largely moulded his own lines of thought. To other writers also, and especially to three brothers, he is very greatly indebted.

With regard to the origin of the universe and its present state, the real meaning of life, the deep and perhaps un-

fathomable mystery of each individual person's self-existence, the stubborn and rock-like difficulty of really explaining any natural phenomenon—with regard to any or all of these questions or any similar problems dealing with the root of any thing or things—the thoughtful man, woman, or child is placed in a dilemma, or rather in a labyrinth of dubiety, at first sight nothing less than terrible, when it is contemplated. Even after the most conscientious thought, the problems with which we are confronted seem merely to involve the mind in a continuous and bewildering train of reflection, a veritable circle or rather sphere made up of the contradictory elements, faith, perplexity, doubt, unbelief, hesitancy, hope. Yet, notwithstanding the many and indeed innumerable obstacles to a simple trustfulness, how exuberant must be our joy when, looking to others as guides, we learn that there are not merely a few, but rather a great majority of men, who hold, and have held, that, even when doubt and despair and the worst doctrines of pessimists have been allowed their fullest scope and received the most deliberate consideration, still there remains for struggling humanity the brilliancy, the grandeur, the glorious blessedness of an unflinching and irrevocable faith in the fair destiny of the human race, in the eternity of good and of God, and also in the continuance of our conscious self-existence for all time. There are, it is true, many men who hold these beliefs; but there are not very many who fully realise the highest warrants for them, and can give strong and weighty reasons for the faith which is in them.

Nevertheless, interesting as these deep mysteries most undoubtedly are, they would yet have been somewhat beside the scope of the subject of evolution, as I have endeavoured to treat it. To have grappled with these greatest of great points of controversy, and to have carried the question of philosophic belief into the region of the various systems of religion with their many different but similar creeds and dogmas, would have been impossible in the space at my command. Moreover, this has already been well and ably done by various writers far more competent to deal with these issues than the author feels himself to be. Consequently, it was merely one of his subsidiary aims just to point out, in passing, the general nature of the grounds on which, from the philosophic and scientific points of view, an enduring and firm belief in the Deity might be rationally based. Infinitely high as such a consideration is, it would scarcely find its best place in a discussion such as that which follows. It occurred to the author that it would be well to

add a chapter dealing with the important topics of belief and disbelief; but it became clear, on reflection, that a bulky volume would alone suffice to thresh out this weighty subject thoroughly, and hence, with some reluctance, it was decided to leave the matter as it already stood, in the hope that at some future time circumstances might allow him to wrestle with this weird question, fraught with such momentous issues as it is, and in doing so to give the highest warrants which can be found for belief by diligently searching the human mind, the customs of mankind, the phenomena of the universe at large.

In view of the many theories and the various beliefs which have actuated men at different times in the world's history, have held sway over human minds, and afterwards been looked upon askance, it may seem rash to say that the theory of evolution, when rightly understood, may be looked upon as the last word of philosophy. Yet we feel assured that this is the case.

All the greatest discoveries of all time have pointed to a belief in evolution, and they receive their fullest and truest explanation when interpreted in accordance with this induction. Indeed, it may be said that it is a difficult matter for those who realise ever so dimly what is meant and what implied by natural phenomena, to comprehend how anyone, who takes in hand to trace the marvellous and involved working out of changes in the world around, can possibly doubt the relative truth of this all-embracing doctrine.

Besides touching upon this widest of all generalisations, widest because it includes all other correct inductions, the author has briefly discussed some implications of an acceptance of the idea of evolution in various fields of inquiry, viz. in regard to the nervous system, pathology, education, ethics, and politics. In doing so he feels that he has exposed himself to the objection that these subjects could not possibly be treated of adequately in the very limited space; but still he is bold enough to hope that some good seed has been sown in the chapters relating to these topics,—seed which it is hoped may bring forth fruit in other minds.

This short treatise may be said to have grown out of a lecture on "the Evolution Hypothesis," which was delivered by the writer some time ago in the Hall of the Diocesan College, near Cape Town. Inasmuch as it seemed to excite some interest, this germ was elaborated into a little work entitled 'The Evolution Hypothesis,' published in 1885, by Messrs. Darter Brothers, and Walton, of Cape Town. Since that time many new ideas have been incorporated, and the

present production is practically a new work. A large portion of what follows has already appeared from month to month in the pages of 'The Veterinarian,' beginning in the April number of the year 1886, and ending in November, 1887.

The chapter on the Nervous System is slightly altered from a lecture delivered in the Mutual Hall, Cape Town, before a large audience, convened under the auspices of the University of the Cape of Good Hope. It was reproduced almost *in extenso* in 'The Cape Times' of May 31st, 1884.

The portion of this work which deals with the science of pathology is, in chief measure, founded upon, and in large degree bodily taken from, a pamphlet entitled 'Some Pathological Bearings of Darwinism,' written by the author's brother, Dr. D. Astley Gresswell, in the year 1884, and published in the early part of the year 1886.

Of all the various fields of human research none can be of greater importance to the human race than that of pathology. In this department of science much careful work is needed. The scope is nothing less than illimitable, and there is ample room for skilled workers in abundance. In these days there is a bright prospect for all earnest investigators into the many intricate questions of disease. Never before has the golden light of truth shone with such clear radiance on the meanings and causation of the normal and abnormal functions and structures of animals and plants. Never before have the opportunities at our command been so great as they are now. More than one genius has already risen up among men, and explained to them some of the many mysteries of pathology. Yet, though a great deal has been done, it is as nothing compared with that knowledge which is but a little distance ahead of us, and which, as it were, like luscious and rich fruit is dangling above our heads, ready almost to fall into our mouths, if we could but see it, but still escaping men's most eager search.

The chapter which deals with Education is founded upon a public lecture delivered at the Diocesan College, near Cape Town, and afterwards published as a pamphlet by Mr. J. C. Jute, of Cape Town, in 1884. Therein it has been attempted to show that, inasmuch as words can only be regarded as symbols of things and ideas, the highest kinds of teaching must involve rather the imparting of a practical and intimate acquaintance with natural phenomena than merely a knowledge of language and modes of expression. It must not be imagined that the use or the knowledge of literature, *quæ* literature, is meant to be disparaged. Indeed it must be very

obvious that things cannot really be well known, except by the acquisition of the power of speaking of them correctly, and in order to gain this facility a considerable amount of literary power must necessarily be developed. Nevertheless, it is of paramount importance that the education of the young should not, as it so often does, merely resound with the vain echoes of words, words, words.

The chapter on Rational Politics, is taken from a pamphlet of that name, written by Mr. Charles Gresswell, M.R.C.V.S., of Nottingham, one of the author's brothers, and published by Messrs. Thos. Forman and Sons, of Nottingham, in 1885.

The chapter dealing with Ethics, based upon Mr. Spencer's 'Data of Ethics,' as also the conclusion, were, in the first instance, communicated almost in their present form by the author to the South African Philosophical Society, of which he was a member, and afterwards appeared, the former in the 'South African Illustrated News,' the latter in the 'Wynberg Times.' It is attempted to show that the determination of what is right and what is wrong, though oftentimes of necessity a complicated and involved matter, is, notwithstanding, one which must be decided on the broadest basis, viz. in accordance with the view that a bad action is one which produces damaging results in self, or others, or both, in short, one which leads to a diminution in the total happiness of mankind. However difficult it may be to adjust conflicting claims in certain cases, still we must conclude that the test mentioned is the truest and best.

Thus it will be seen that the book as it now stands is essentially a product of gradual growth, of evolution, and the author hopes the sale will be such as to give him, all being well, a chance of again improving and adding, in years to come. To his brother, Dr. Albert Gresswell, physician, of Louth, Lincolnshire, the writer's grateful thanks are also given for much most valuable assistance and advice, and written and printed information.

Ideas and statements have been taken from divers sources, some consciously, some unwittingly; of these some have taken forms different from those in which they were originally presented. Many have been more directly utilised. Many are, the author thinks and hopes, original. While acknowledging that various sources of information have been used, and that the honour belonging to any good work which may perchance be found in this book is largely to be ascribed to others, the author wishes it to be clearly

understood that the entire responsibility of every statement and belief rests with himself alone. Finally, he hopes that 'The Theory of Evolution,' in its new form, will prove even more acceptable to an indulgent public than previous ventures.

KELSEY HOUSE, LOUTH,

LINCOLNSHIRE ;

Thursday, January 12th, 1888.

THE THEORY OF EVOLUTION.

INTRODUCTION.

IF it be admitted, as it most indubitably must be, that every possible human conception, theory, or belief, is, and must necessarily be, more or less mechanical and anthropomorphic, then it will be sufficiently clear that all we can hope to find in the way of an explanation of things is a general plan or generalisation, which, as far as we can see, best explains facts known as we know them.

Bearing in mind that all possible methods of mental arrangement of phenomena are in large measure mechanical, and purely relative and provisional, how shall we formulate and picture to ourselves a process or mode of procedure which, while being so far mechanical as to be orderly, is nevertheless no more artificial than is necessary, so that we may be enabled to see and to recognise an invariable and inevitable connection between actions and results, between causes and effects?

This mode of connection between phenomena, which we are seeking, will, it may be hoped, when found, seem to be the one most nearly approaching supposed truth; and we may say of it that it must certainly not be one which is entirely rigid, exact and inert, fixed and motionless.

Such an artificial conception would fail not only to satisfy our highest aspirations, but would also fall short of attaining to what might almost be designated an ordinary and everyday standard of completeness.

Some ideal belief, it must be confessed, is most highly desirable, and can probably be satisfactorily accepted. In fact, we venture to say, "It has been found."

Important as it is to begin at the very beginning of a

subject, and to work it out in a steady and continuous train of thought consecutively from end to end, it is quite impossible literally to pursue this desirable method of treatment. This is a most suggestive fact, arising as it does from the inability of thinking at all, without accepting as proven many points which really admit of dispute.

Yet we are always striving, and must always strive, to dispense with unfounded or dubitable assumptions; and though we may fail most lamentably in our attempts, it is unquestionably obvious that the more nearly we succeed in probing to the deepest springs of truthful, conscientious, thought, the more satisfactory must our results be considered to be.

What is it, then, that we are essaying?

It is nothing less than to divest ourselves of all preconceived ideas, each one the result of long-continued and obscure processes of changing transformations of matter, most involved and complex, and proportionately difficult to unravel, even ever so slightly and superficially.

Bound by all that has occurred during the past history of our progenitors, as well as by all that is now occurring with reference to ourselves, and unable as we are to trace the workings of things around us more than most incompletely we may well hesitate before we accept without question any ultimate explanation of things whatever, as an adequate one. Over external processes of change we have, and have had, obviously, scarcely any control.

Even in the case of our own mental operations we have but little power; only, in fact, so much as is implied by the indubitable possession of a certain amount of will, stronger or weaker, as the case may be, apparently never very great, and varying, moreover, not only among different nations, more or less highly civilised, but also to a large extent among different individuals, and even in the same person, according to the general bodily state, and to surrounding conditions, as circumstances may determine.

Would it not then be unquestionably absurd to place great reliance on such a varying and changeable factor as the power of will, or of thought, of any one individual or nation, or group of nations or peoples, manifested during the course of their respective very limited periods of existence?

Still we must, in theory at least, throw ourselves, as it were, backwards into a state of hypothetical freedom from all prejudice and superstition. We must fancy ourselves, so far as is possible, unguided and unaltered by outside

forces—nay, even, were it not presumptuous, we must attempt to reach absolute reality.

Moreover, since it is obvious that we cannot do this at all satisfactorily, it follows as an irresistible conclusion, in spite of the limited and fallacious nature of human reasoning, that thoughts which have had the widest acceptance among mankind, are those which have the highest warrant, and must be supposed to approximate most nearly to the truth.

If we cannot admit this, then there is no alternative but to conclude that life is a huge, vapid, and meaningless farce, that it is simply absurd to hope to set at rest any of those great and grave problems which, in all past times, have occupied the toiling human mind, striving to pass beyond its bounds.

Now, the widest, the deepest, and the truest of all generalisations, which have ever been arrived at by the human mind, is the theory of evolution. It embraces everything, both small and great, within its giant's grasp; and it affords the expression of that unity of nature, which we are justified in regarding as a union of multiformities. It is the widest application of that law of causation which all admit—which all are bound to admit in some sense—and finally, it gives us the only key and clue to the method of action of the unknown reality, the Great Mysterious Power, to whom all must bend and bow.

It would scarcely seem necessary to warn people who think, against the absurdity of regarding the evolution hypothesis as an ultimate explanation of all things. All that we claim for it is, that in the present state of scientific knowledge it affords the readiest uniform plan or process, on which we can most easily conceive all things to have worked, and to be working. Those who admit the evolution theory must either say, "We accept it provisionally as the best general expression of the origin of the universe and its contents, and about the real explanation of things we know nothing;" or else they must hold that—

"Although we do not know anything as an absolute and verifiable reality, yet we consider ourselves for numerous reasons fully justified in the assumption of a Guiding Power."

No other statement would, I think, recommend itself to the truly philosophic evolutionist.

In any case it would be simply absurd to say that evolution is the sole cause of everything. This is so palpably evident that no more now need be said about such

a manifestly unthinkable proposition. In our remarks, then, we shall endeavour to use the term evolution in a limited sense, as a word used to signify the relation of cause to effect, than as a word in itself denoting causation.

For the first appearance of all the theories which are now agitating the world we should have to search in the writers of antiquity, in the records of a time long gone by, in a period of history far more remote than the age of Spencer, Darwin, Lamarck, Dalton, or Pasteur.

Nothing is new under the sun, and the evolution hypothesis, the atomic theory, and the germ theory of disease are not entirely novel. The only sense in which they are new is that they are more widely and differently applied, being now supported by a mass of overwhelming evidence, which is all but convincing in its character in each case.

Further, but few theories can withstand and prevail against minute criticism. Their provisional truth is all that can be granted.

The idea of evolution seems to have arisen in very early times, and all that we can claim as of modern origin is its far greater applicability and breadth of scope.

It has been almost quite recently trimmed, as it were, to fresh orders of facts, until now all phenomena of whatever kind are supposed to come within its range.

Especially is the extension of it to animate beings of the greatest possible interest and value. Applied in explanation of the processes by which the highest organisms, including man, have been gradually produced, evolution may be said to have had the unremitting sanction and support of very nearly all the most distinguished scientists of these times; and it must now be regarded as a provisionally established induction, undoubtedly by far the greatest and the widest which modern thought has produced.

Mr. Darwin has done most for the extension of the theory to living organisms.

Views similar, however, to those of Mr. Darwin were put forward by Mr. A. R. Wallace, in 1858, while Mr. Darwin's book, 'The Origin of Species by Natural Selection, or the Preservation of Favoured Races in the Struggle for Life,' was published in 1859.

So long ago, however, as 1837, Mr. Darwin appears to have begun to collect materials for his book, so that the priority seems to belong to him.

Mr. Herbert Spencer, who has indubitably done far more to place the theory on a philosophical basis than any other writer, also has very distinct claims to priority; for in 1855

he interpreted mental phenomena entirely from the evolution point of view.

As for the theory, however, ranking at all as a recent discovery, great doubts must be entertained; though it is true that it has assumed definite shape, only in modern times.

Those who are acquainted with modern literature, well know how deeply the character and colour of it has been affected by the theory of evolution.

It is not too much to say that there is not a single department of knowledge on which new light has not been thrown by those who hold and apply this doctrine; and there can be little doubt that evolution will at no distant date furnish us with a marvellous clue to many known facts of physics, of chemistry, of pathology, and other sciences, now enveloped more or less completely in mysterious obscurity.

Yet it is strange how very few, even of the most highly educated people of to-day, ever concern themselves seriously with attempts to set at rest, once and for all, so far as they can be decided, those great problems presented by our existence here as inhabitants of a wonderful world.

What part do we play for so short a time here on the earth? What is the rationale of all natural events?

Whence arose the universe, and whither is it tending?

What will be the climax;—or will there be a climax?

Let us grant that all things are the expressions of a great reality, that they are in all probability the products of an Almighty Power. The question still remains:—What evidence have we of the method of working and procedure which has been, and is being, adopted?

These are not unimportant considerations, nor are they to be shunned on any religious grounds; for reflections of this nature can only tend to exalt the conceptions we must form of that supreme and mysterious energy, to which or to whom all results are due.

Even the most unthinking and callous cannot fail to have been at times struck by the wondrous and seemingly insolvable problems of the universe and of life.

Who, inspired, as most of us must at times be, by the beautiful scenery of the world,—who, while gazing from the sea-shore outwards to the far-distant mountains which encircle the bay, tinted by the wondrously coloured hues left by the evening sun—who, as he observes the splendid play of colours, distinct, yet so marvellously blended, that it is impossible to say,—“Here the one colour ends, and the next begins;”—the green and yellow on the mountains in the region of the west, whence the departing monarch of

light has but lately glided downwards, the red and purple and violet, and deep blue, and rough brown—who, while he sees the rippling waves reflecting back light all around—who, at such times as these, has not pondered and wondered on the two-fold marvel, the problem of Himself the spectator, the hearer, the thinker; and the far greater wonder of the Grand Universe regarded as an objective reality, far transcending even subjective existence, in its inscrutable nature?

Who cannot spare some hours for reflection on such mighty wonders?

An ever-increasing love of knowledge cannot for ever be beaten back like waves of the sea, from the great and stubborn rocks of perplexity, doubt, difficulty, and despair. An ever-increasing enthusiasm in the pursuit of it, must be far more successful in the future, than it has been in the past; and it is not to be taken lightly that the knowledge and power we possess to day, would have been held nothing less than miraculous but a few years ago.

This little contribution to thought, is, in all humility, thus offered to those who think, in order that haply some sunbeams of light which have helped in recent times to illumine with a golden lustre the question of the real meaning of life may be, if ever so slightly, helped onward in their gloriously radiant passage, and may shine a little more brightly to tell us how to live.

If we realise that throughout nature rapid processes of change are continually going on; if we remember that the life of man is purely and simply composed of innumerable actions, either in the direction of advance on the one hand, or in that of retrogression on the other; if we fully appreciate the fact that a state of complete rest is not possible, but that we must either improve or deteriorate—then must our conception of what constitutes good life and good work be seriously and radically modified.

It is therefore of the very highest importance that we should have definite views on this matter, and act in accordance with them. If it be true that all things going on around us are simply processes of integration on the one hand, or of dissolution on the other, it is clear that all things must be interpreted in a manner consonant with such changes.

As there are but few who are well content to go on from day to day, doing their daily routine of work mechanically, never reflecting on the idea of some grand and great purpose and scheme in life; the value of the task proposed must be

considered in some degree to exculpate the author from a charge of presumptuous rashness, in treading again the ground already well worn by some of the ablest and worthiest and best of men.

CHAPTER I.

The Two Opposing Tendencies, Integration and Disintegration.

ALTHOUGH it is undoubtedly true that it is possible to form an almost innumerable variety of opinions on any and every subject, still it is indisputable that, as a matter of fact, in a majority of cases men generally do hold one of two extremely divergent views. Either a thing is good or bad, true or untrue, desirable or undesirable.

In fact it seems possible to distinguish two chief processes in nature; and not only two processes conceived as now in action, but also two great plans, two methods of arrangement, two modes of aggregation, two opposing aspects of phenomena. We shall see this exemplified when we mark that, inasmuch as we can only think of anything as in relation to some other thing or things, we must either conceive of it as a whole containing and including portions, or we must look upon it as itself constituting a part of a greater whole.

Herein, perhaps, we have an explanation of the dualistic view. Supposing, however, that instead of looking upon an object as having now a fixed existence, we regard it as having existed in the past, and as likely to continue its existence into the future; we shall find this idea is not entirely satisfactory.

It must be clear that the beginning and the end are separated by a continuous period of existence, so that we are led to reflect quite as much upon the middle stages as upon either the commencement or the final stages.

Thus we have exemplified the fact that more moderate views on all questions are really far more clearly indicated than are the extreme ones.

While, then, there is a marked tendency among men to look

upon the same thing either as a whole or as a part; either as being at a starting-point on the one hand, or as having reached the goal on the other; it would rather seem to be clear that in reality nothing is to be considered as presenting either the one condition or the other, except as in relation.

We can look upon nothing as being fixed, definite, and certainly established. There is no such thing as perfect stability and equilibrium.

Regarding the twofold aspect of nature, we find that in correspondence with our two ways of looking at things, there are apparently to be discerned, as we have said, two kinds of change throughout nature, or two methods of matter-transformation. These two ways in which things seem to alter from time to time may be distinguished as a process of differentiation, by which things are made more and more different, and disconnected, and dissimilar; and as a process of integration, by which they are brought more and more intimately into mutual connection.

These two changes frequently seem to go on, hand in hand, strange and apparently contradictory as this may at first sight seem. For instance, in the highest animals, there is shown on the one hand the very extreme of minute subdivision of parts, and on the other the greatest connection between the diverse constituents. So also among communities, that is undoubtedly the highest which shows the greatest social division of labour. This corresponds to the physiological division of labour in organisms. In each case the greatest subdivision of function subsists, together with the greatest amount of co-ordination possible under the circumstances.

It may be urged that this view of a twofold method of change is somewhat artificial at least, even if not inconsistent, but it must be borne in mind, as pointed out above, that any conception we can frame must necessarily be to some extent artificial.

Setting aside, however, the consideration that any explanation must be by the very nature of the case mechanical and inexact, the more we think about this double mode of change the more general does the application of it appear to be, and the more obvious its provisional truth.

The marked appearance of uniformity, together with multiformity, the combination of arrangement and order, together with irregularity and disorder, the former in each case being most striking, if least apparent to the casual observer, are but examples of that dualism which we can everywhere see. In connection with this, and as an explanation of it, the fact mentioned above that each aggregate,

whether large or small, can be looked upon either as constituting a whole in itself, or as being but a part of a more extensive whole, must not be forgotten.

No one who views any fine natural scene, whether it be a beautiful bay surrounded almost entirely by lofty mountains, like giants darting huge dark shadows at departing day; or an inland landscape with the valley of a river in view, and the river itself broken from its even course by many a rocky crag; or perchance a grand cataract, that most imposing spectacle in nature; or a fine sunset or rainbow, with its wonderful play of colours; can fail to be struck by the marvellous combination between two diametrically opposite extremes of unity and multiplicity, of symmetry and asymmetry.

On the one hand unity and on the other multiformity are everywhere obviously, even obtrusively, manifest.

The latter of these is of course most readily seen, but there can be little doubt that one who perceives most clearly the one-ness and unity of things, possesses a broader and a deeper insight than he who only marks the incongruity of details. Undoubtedly, he who sees similarities and connections between different objects exhibits a keener intellect and a wider intelligence than he who merely observes the differences. The conception of one force shown throughout nature is greatly preferable to that of many. Is it not significant that the theistic conception, which more or less clearly has become so widely prevalent among nearly all the races of mankind, is the same one to which philosophic scientists, starting with very different ideas, have also been led?

Nevertheless there can be no doubt that all things can be regarded from two most distinctly divergent and opposite points of view; and, though it may be objected that it is very possible to over-estimate the importance of this fact, since all things can obviously be looked at from very many more than two distinct standpoints, and because it would be better to combine the two extreme ideas, and to unite them into one medium view, it is none the less noteworthy, striking, and useful, if only for the sake of argument, to re-consider and again discuss this opinion. An illustration of that contradictory dualism which is so universal in all things may be here not misplaced, although it be in the region of sentiment.

In Leyden in the year 1574, after the siege, we are told, in Motley's 'Rise of the Dutch Republic,' that after the relief of the city had been effected, nearly every living person repaired without delay to the great church. The starving

and heroic citizens, who had been so firm in their resistance to an earthly king, now bent themselves in humble gratitude before the King of kings. After prayers the whole vast congregation joined in the thanksgiving hymn. Thousands of voices raised the song, but few were able to carry it to its conclusion, for the universal emotion, deepened by the music, became too full for utterance. The hymn was abruptly suspended, while the multitude wept like children.

See here thus dimly portrayed an intensity of nervous excitation, communicated like an electric shock from one to another throughout a dense crowd; a degree of feeling which, in the midst of rejoicing, brings forth those manifestations, habitually associated in our minds with the bitterest grief and despair!

Similarly it has been observed that a good lover is a good hater, and this apparent antagonism of qualities displayed by the same individual is much more clearly seen in the fact that those who, by reason of their high nervous development, are capable of feeling the greatest happiness, are often the very people who occasionally experience the greatest misery.

In short, it seems to result as an inevitable conclusion from observed facts, that the interminable struggle between the good and the bad, each striving for the mastery, must, so long as things are ordered as at present, continue; and this is true both of communities and of individuals. In fact it may be said that throughout nature a similar rivalry is to be traced.

Two chief modes of thought, two opposite processes, two opposing views, two diverse opinions, are everywhere sufficiently apparent. A good illustration of this is shown in the mode of origin of language.

"Tracing back the history of language," remarks Dr. Carl Abel, "to that remote period when our primitive ancestors were struggling with the difficulty of forming and expressing definite thought, the progress of investigation brings out more and more clearly the fact that there was once a time when not only in thought, but in name, contradictory ideas were identical, when in fact black was white."

"The oldest preserved specimens of human speech are handed down to us in Egyptian literature.

What we read in the Egyptian literature of the last 4000 years before Christ is the language of an era much more antique than the oldest tablet rescued from the wreck of time. In it we are startled to find a large number of words with two meanings, one the exact opposite of the other, and also

compound terms combining words of opposite signification, and yet conveying the sense of only one of them.

For instance, the compound vocable "old-young" meant "young" only, and "*ken*" meant both "strong" and "weak." The matter is simpler than it seems. Were it always light what should we know of darkness; and again, were all things of the same size how could we distinguish great and little?

The presence in the mind of two ideas was required to enable primitive man to realise either, and both were therefore equally embodied in certain words. It was by gesture that the particular meaning of a word with two opposite significations was indicated; and, in writing, if the Egyptian word "*ken*" meant strong, it was accompanied by the picture of a man standing erect and sometimes carrying arms; while if it meant weak, it was followed by the image of a languid person, squatting on the ground in an exhausted way. There was no fear that a maiden could have misunderstood her lover when calling her pretty, in language which might have borne the treacherous interpretation of plain. Doubtless his attitude sufficiently denoted that the former signification was intended.

Although in later times the word with two opposite meanings is replaced by two different words, each having only one of the two significations; even in our English language at the present day we have still words with two distinct and opposite meanings.

The history of language then furnishes an excellent example of the two-fold aspect, from which all things in primitive times must have been, and still must be, regarded.

This antagonism is explicable on the idea that each and every particular object or group of objects is only to be considered as presenting relationship to other objects or groups of objects, so that for instance the idea of the whole and its part are not only relative the one to the other, but also to other wholes and to other parts.

Again we all know that in union lies strength, and the old fable of the dying father who impressed this fact on the minds of his sons, by pointing out to them their inability to break a bundle of sticks, and the ease with which this result might be attained, if each stick were dealt with separately, has also undoubtedly served to make us, too, more familiar than we should probably otherwise have been with the advantages of united action.

It is, however, none the less true that by independence and individual energy also great things can be achieved.

Thus we have two opposite views of conduct, both right, both capable of being abused.

And here, as in all analogous cases, the medium course, the resultant of the two opposing proclivities, is indubitably better than either.

We do not here propose to treat of the rival views, optimism and pessimism, as an instance of what is meant, because this would lead us far from the present subject; but these two distinct theories do afford perhaps the best examples of two opposite beliefs.

Leaving this, however, let us consider what are the head-ings into which biology, as a science, is sub-divided.

At the outset of a consideration of the phenomena of life, we are met with a striking instance of two points of view; for while some biologists prefer to lay the greatest stress on the structure and form of organisms, thus creating the branch-science of morphology; others are rather induced to consider the functions which they perform, and the uses to which structures and organs are put, that is the physiological part of biology, as of the greatest interest and importance.

We find, too, that though these two ideas of structure on the one hand, and of function on the other, are radically distinct and dissimilar in theory, still in practice it is quite impossible to separate them completely.

Again, the great central point or plan upon which biological and in fact all generalisations may be said to depend, is undoubtedly the Evolution Theory itself.

Later on will be given the briefest possible sketch of the gradual progressive changes, through which we must suppose the universe has passed, during the countless millions of years of the world's history, from the simplest forms of matter known to us.

Were it possible, without enlarging too much the bulk of this production, it would be of the greatest advantage to show how the series of changes, from the simple form in which a man's individuality is first distinctly discernible, to the complex form of the adult human being, typifies in the most striking and complete manner the stages through which we suppose the successive progenitors of man in the dim vista of the far-off past in reality progressed.

We should find also, if time permitted the discussion of the subject, that a most remarkable similarity of fundamental structure could be made out in all tissues of all organisms; we should come to the conclusion that the highest living beings can be considered to be built up of cells, similar to the lowest unicellular organisms; and we

should recognise in the very general presence of a nucleus provided with nucleoli in the midst of the cell-substance, and also in the intracellular and intranuclear network, almost universally to be distinguished as the intimate structure of the cell, still further, and most remarkably significant, points of resemblance, in the ground-plan, so to speak, on which all living things are built up.

Thus we should perceive evidence of the strongest character for the assumption that living beings have been gradually perfected in past times ; that both animals and plants have, as is supposed by most of those who are most competent to form an opinion on the subject, arisen from primitive living organisms, themselves neither plants nor animals ; and these from non-living matter by a most gradual series of changes, countless in number, well-nigh limitless in scope and duration.

What will be said, however, when it is seen that the Evolution Theory itself implies the action of two distinct and opposite processes, that of integration on the one hand by which things are rendered more united, and that of differentiation on the other, which, when extreme, necessarily leads to disintegration, in virtue of which they become more disunited, and distinct, and different ?

Though, too, at first sight this looks very much like a direct contradiction, we shall recognise on inquiry, and after mature deliberation, that the highest aggregate we can conceive must necessarily combine the greatest internal freedom of movement with the very strongest union for the support of the whole.

This is actually what we see to the greatest extent obtaining in the most highly developed aggregates, whether of things or of animals, or of men, or of the parts of which each individual organism is composed.

Of course there must be a preponderance of the integrating factor, so to speak, and we may therefore almost prefer to look upon increasing integration as the most essential and distinguishing aspect of progress.

The fact is that we can symbolically look upon all portions of matter, whether large or small, as tending to incorporate other surrounding portions of matter, and thus to become larger in size : but we must remember that, in order to be effectual, the kind of union must be such as will endure to some marked extent ; and also that there is always a natural tendency remaining for the incorporated portions to integrate on their own account, and thus to a greater or less extent to disturb and destroy the consolidation of the primary aggregate.

Bearing this in mind, instead of wishing to check this tendency to integrate and to progress on the part of units, whether individuals or societies, we shall be the rather prepared to encourage it, so that though the moving equilibrium of the whole system may be very materially altered, still there need be no absolute disunion and disintegration.

Now these two ideas of integration and disintegration seem to lie at the very root of our mental faculties, and in attempting to combine them and form from them one complete conception, we have to think of them as both co-operating and conflicting in manifold ways and degrees. This it is extremely difficult, if not impossible, satisfactorily to do; and it may be repeated that the confusion attending our conception of Evolution, being inseparably connected with our methods of thought, is a confusion from which we cannot entirely free ourselves.

There can be no doubt that a dualism is apparent throughout nature. As urged above, any given object or group of objects can be regarded either as an integer in itself, or as constituting a part of a more extended whole.

These two entirely distinct aspects of the same thing may be looked upon as corresponding and connected, to some extent, with the two ideas of Evolution and Dissolution. The terms dissolution and disintegration are used almost synonymously, and may be regarded as the extreme results of great differentiation, though this last word is generally used, with the implication that the integrating link is maintained.

It is probable that, regarding an object or group of objects as a whole, an integer made up of constituent parts, we are apt to carry in our minds a kind of implication that it has been built up by means of coalescence of parts; while on the other hand, when we think very emphatically of the part, we are apt to carry back our conception in imagination to a probable point of time in the past, when it was not sufficiently distinct even to be recognised as having that amount of individuality which is necessary for the realisation of separate existence at all. In fact, the more we think about it, the more clearly we shall see, that the conceptions of the part and of the whole are thoroughly relative, the one to the other, in virtue of the very conditions of thought.

Now if we picture to ourselves a tendency in all things either to increase in size by absorption and assimilation of external substances on the one hand, or to diminish in bulk by loss of some connection of its different parts on the other, we should imply, taking the case of the matter and

motion making up the universe, either that it would eventually become as solid, as connected, as greatly integrated as it is possible to conceive, and that all motion and all change would at length almost entirely cease; or else, on the other hand, that all matter would in the dim future be again infinitely diffused, as we may suppose it to have been in the far-off past.

Complete rest and death of the universe must naturally and necessarily be the ideal of complete integration; while indefinite tenuity of matter in infinite space must equally ostensibly be the ideal of complete dissolution.

Nevertheless, it is obvious neither the one process alone, nor the other, must be considered to be going on in isolation.

We have to conceive the combination of the two tendencies, that, namely, of each and every portion of matter to take care of itself, by absorbing surrounding portions in its neighbourhood; and also the liability it is always undergoing to be, in its turn, absorbed. Some such compromise as this is what we are reduced to, when we attempt to analyse natural processes.

There is no alternative. This must be our conclusion. We have to make a rational conception of two seemingly contradictory processes.

Evolution must be understood as implying the greatest amount of integration possible, when we consider that the integration of any constituent portions is always checked by the increasing integration of other portions.

A balance has been, and is being effected, between the two extreme states of extreme integration and extreme dissolution.

If we bear in mind always that both processes are continually going on (the progress of a society, for instance, being consistent with the deaths of individuals), we may look upon evolution as increasing integration; for it is undoubtedly this to the greatest extent which is possible, when due independence of units is allowed for.

We repeat, then, that the complete idea of evolution seems to involve two distinct processes, the one of increasing integration and the other of increasing disintegration, going on hand in hand, and partially obscuring one another; and the resultant of these two processes would seem to be that there is a tendency to the increase of the kind of connection which is most essential. Each aggregate, whether large or small, is increasingly characterised by a particular kind of inter-dependence among the parts which compose it. It is, of course, of far greater moment to understand clearly

of what nature integration must be, in order to produce a higher aggregate, than to regard merely the absolute amount and extent of union produced. Mechanically fixed integration is not desirable; but that kind of it is to be sought, which ensures essential union in all points on the one hand, and loses nothing, or as little as possible by friction, on the other.

In fact, as indicated previously, the highest aggregate must be that which best combines the two extreme states, of almost indefinite subdivision and independence on the one hand, and the most extensive and complete union and connection with regard to all essentials on the other.

It is true that we can look upon and explain all the phases presented by any given object, or group of objects, as either integrating or disintegrating; or as presenting both processes simultaneously for contemplation.

We must strive to obtain a mental combination of the two processes of integration and disintegration, between the production of aggregates or wholes, on the one hand, and of parts on the other.

We see then, both when we consider each small part of the sum of things, and when we rather regard the universe as a whole, that there is presented to our view a combination of opposing processes, a compromise, a resulting median series of changes. The tendency each part exhibits to become more intimately connected with surrounding objects, must necessarily to some extent neutralise the similar tendencies, which the latter also possess on their own account. Thus it becomes true that the kind of integration which is alone possible, is at the same time the very best in the sense that it is the most stable, having been produced as the resultant of the various factors at work. Thus the maintenance of the most suitable kind of cohesion is ensured.

Hence, instead of looking upon the universe to be produced in the future as one huge solid block, we find the integrating tendency of each constellation helps to maintain its individuality, and so to prevent this undue and fatal kind of union referred to. When we think, then, of evolution as consisting more especially of increasing integration, we have to check this, which is really a one-sided view of union, with a view which, while admitting the highest kind of combination of constituent units, individuals, and forces, does not preclude the idea of distinct independence and individuality among them. This, in short, must be our ideal of probable progress, that, namely, of the greatest possible amount of union among the most diverse constituents.

For all human purposes, and especially as a purely human guide to conduct, this is probably the truest representation of phenomena.

We must suppose that the highest result is one which combines the greatest possible amount of differentiation or independence, with the greatest possible amount of integration or union. Of course, if we do not forget to keep in our minds the reverse picture of differentiation, we may speak of integration alone, since it is much more conspicuous in advancing aggregates.

If we consider the universe as a whole composed of parts, then the integration of the whole means the loss of the integrating processes of the parts; and the integration of any one part must mean opposition to that of the whole. The integration of the whole must mean, to some extent, the loss of individuality of its constituents. The integration of parts to make a whole presupposes overthrow of the forces which previously kept those parts distinct; while, if we suppose them to have been previously forming parts of another whole, we have to suppose disintegration of this previous whole to have already taken place.

If, however, we consider evolution as the product of the two processes, we have to think of a close union of very distinct and independent parts, and this it is, to which we are reduced. Since, then, everything can be regarded from two diametrically opposite points of view, we cannot extricate ourselves entirely from all mental difficulties. If, however, we always bear in mind that everything is to be considered as essentially relative to everything else, a fact which cannot be too often repeated and reiterated, we may possibly be able to blend, and combine in some degree, the two distinct aspects. Thus it happens that when we try to probe to the very bottom, our ultimate ideas of the two opposing processes, integration and disintegration, we find that each is capable of being thought of in connection with the other.

With regard, then, to these two processes, the one of increasing integration, which is sometimes designated evolution, and the reverse process—namely, that called dissolution or disintegration, there is undoubtedly room for some confusion.

Are we to consider evolution as being in the main an increasing integration, or must our conception of it include the dissolution which is always going on, and in the case of the higher organisms (the metazoa) at least, is in the shape

of death, entirely predominant in the final issue?* If it means the resultant of both processes, as it certainly should, though a large portion of the difficulties attending our conception of evolution are removed, is there, or is there not, still involved some contradiction in terms and in ideas? We have to think not only of each part of the universe, but of the universe as a whole. If so, it is manifest that we have to think of the universe as a whole progressing to a more perfect equilibrium, as well as of each portion doing the same. This, to some extent, seems contradictory, unless we look upon the universe as the only aggregate which is really progressing, or which is progressing in the only true sense.

The real fact seems to be that advancing evolution of the universe must be regarded as the resultant of all the changes which are going on, and have gone on, in it, whether of integration or of disintegration; and that on the whole, though obscured from time to time by retrograde waves, the resultant is, nevertheless, in the direction of a greater combination of increasingly different parts. We suppose, for instance, that in the dim past the whole of the matter in the universe existed in a widely diffused state, and we know that now it is concentrated in the form of the numerous heavenly bodies. Still it must be admitted that this view is not altogether satisfactory, even if it is not suggestive of contradictions and inconsistencies.

We conclude this chapter with a brief abstract of some of Mr. Spencer's views. In his 'First Principles,' Mr. Herbert Spencer tells us that our acquaintance with any object is not complete until we have ascertained in some degree its past, present, and probable future history. We have such knowledge, more or less complete, of all things. This knowledge science has extended, and is daily extending still further. Concerning any man, we know that he has passed through the stages of infancy, childhood, and youth; and of his future we can predict that he will die, and that his body will decay. To the biography of the individual man or woman science adds a history of him or her, beginning as a small cell, about one hundredth of an inch in diameter, possessing but little structure or differentiation of parts; while on the other hand we are informed concerning the nature of the ultimate gaseous products of decomposition, into which the materials of his body will at last be transformed. Similarly in the case of all objects, the past, the present, and the future present themselves for consideration.

* At what stage in the series of organisms can *death* first be accurately traced?

Thus we see that, beginning with an almost diffused and imperceptible state, we pass through a concentrated and very perceptible state, and finally end again in a diffused and almost imperceptible state. These two processes may be called respectively evolution and dissolution, and all natural objects exhibit closely analogous processes.

Further, when we consider these changes in detail, we observe that the change from the diffused to the concentrated state, which we call evolution, consists at once in a dissipation of internal motion, and a concomitant aggregation of matter; while the converse change from the concentrated to the diffused state, which is styled dissolution, involves an increase of internal motion, and a disintegration of matter.

Evolution and dissolution, then, are to be regarded, in point of fact simply as redistributions of matter and motion. Thus a gas has great internal or molecular motion, a liquid less and a solid least; and the change from one kind of aggregation of matter into another, is seen to be in chief part the result of an increase or diminution in internal motion.

Nevertheless, while all objects are continually undergoing more or less rapid changes in these respects, and while the change is always on the whole in the direction of greater integration or in that of greater disintegration, as the case may be, the one process is always complicated or obscured by concomitant changes in the other direction.

Hence we see evolution and dissolution going on together in the same aggregate, though one process must always be on the whole in excess of the other.

We have then many complex factors to consider, and there must always be great difficulty in tracing out transformations so vast, so varied, and so intricate.

All sensible existences must have reached their concrete shapes through processes of concentration.

Our sidereal system, by its general form, by its clusters of stars of all degrees of closeness, and by its nebulæ in all stages of condensation, gives us grounds to believe that both generally and locally, concentration is going on. If we assume that its matter has been, and still is, being drawn together by gravitation, we have an explanation of all its leading traits of structure; from its solidified masses on the one hand, to its collections of attenuated flocculi, barely discernible by the most powerful telescopes, on the other; from its double stars, up to such complex aggregates as the nubeculæ.

So also in the case of the solar system, the belief that this

has had a nebular genesis, is a belief, that it has arisen by the integration of matter and the concomitant loss, or rather dissipation, of motion.

The history of the earth carries us back to that molten state, which the nebular hypothesis implies. The passage from a thin solid film of crust, everywhere fissured and moveable on the subjacent matter, to a crust so thick as to be but now and then very slightly dislocated by disturbing forces, illustrates the same process of dissipation of motion and integration of matter.

Similarly, organic evolution is primarily the formation of an aggregate, by the continued incorporation of matter, previously spread through a wider space. Every plant grows by the concentration in itself of elements that were before diffused, while every animal grows by re-concentrating these elements, previously contained in surrounding plants and animals. Together with the formation of a larger aggregate, there is also a drawing together of the matter into parts, as well as an increasing combination of the parts thus formed.

In the mammalian embryo, the heart is at first represented by a long pulsating blood-tube, which soon twists upon itself; and the different parts of it are combined gradually, into the form of the central circulating organ of the adult. The butterfly has its segments so much more closely united than those of the caterpillar, that some of them are no longer distinguishable. Combination is also shown in societies of animals. The social insects are so distinct among themselves, that the separate individuals cannot exist, if isolated. Finally, the different classes of organisms are mutually dependent to a marked extent.

Animals live directly or indirectly on plants, while plants can assimilate the carbonic acid gas excreted by animals. Again, a large number of plants are able to continue their respective races only by the aid of insects, and in many cases particular plants need particular insects.

Further, the flora and fauna in each area are sometimes so far connected that many species die out, if placed amid the plants and animals of another habitat.

Similarly in the social organism, changes in the direction of increased connection and dependence of one part on another are abundantly exemplified. Wandering families join to form tribes; and the subjugation of weaker tribes by stronger ones, is a progress of like character, while among superior races such combinations become far more per-

manent. A far more wide-reaching change of like kind is foreshadowed in the tendency, among the most enlightened nations, to form alliances more or less lasting, in the system of settling international disputes by congresses, as well as in the breaking down of commercial barriers, and the rapidly increasing facilities of communication.

Is it possible that, for example, a European federation, or a close union of all English-speaking peoples, may in the future still more clearly indicate this integrative tendency among human beings, which is shown by all things, in a greater or less degree?

Further, of the different classes of a society, the members of each are held together more or less closely by certain privileges and characteristics.

Again, we have the absorption of particular industries in particular places; for instance, the pottery manufacture in Staffordshire. Yet again, the bankers, the publishers, the doctors, tend to collect in certain particular parts of a city.

The histories of language, of science, and of art, all show this same tendency to increasing integration. Science presents numerous instances.

Indeed, correct classification (*i. e.* the grouping together of the like, and the separation of the groups thus formed from other groups) constitutes the most conspicuous part of scientific progress. Again, a decided connection has been seen of late to exist between the phenomena of electricity, magnetism, and light; and there is no doubt that in the future we may see a still more definite interdependence. In art, the progress from the rudest tools to the most complex machines is an increase in combination. When we compare the mural decorations of the Egyptians and Assyrians, or Bushman paintings, with modern works, we see clearly how much more completely unity and connection of diverse minutiae are displayed in the latter; while the former in reality consist of numerous distinct figures, presenting very little mutual connection.

Now we recognise that the chief test of merit is the extent to which unity of effect is deduced from variety of constituents.

In music too, on the one hand, we find among savages chants composed of a cadence embracing but a few notes repeated monotonously; and on the other we have such grand compositions as those of Beethoven and Wagner, by whom unity of effect has been studied and elaborated, and most wonderfully carried into successful execution.

In literary delineation it is generally observable that a

good sermon, a good lecture, or a good novel, invariably illustrates some chief leading idea, some characteristic conception; and many modern sentences display a degree of integration greater, perhaps, than was in former times generally apparent.

Evolution may be defined as a change from an indefinite incoherent homogeneity to a definite coherent heterogeneity, accompanying the dissipation of motion and the integration of matter.

In interpreting evolution, then, we should have to consider the various resolutions of force, which accompany the primary and the secondary redistributions of matter and motion. The changes with which evolution commences are necessitated by the instability of the homogeneous, and such changes must continue.

The more homogeneous must lapse into the less homogeneous. Such forces as produce sensible motions of the parts of an aggregate cannot but work the segregations which we see taking place.

We are led to the conclusion, then, that the entire process of things, alike displayed by the universe as a whole, and by its minutest portions, is in each case similar; and that it is divisible into two great processes, both alternating and conflicting, viz. evolution and dissolution.

When the integration of our solar system has reached its climax, there will remain to be accomplished the integration of it with other systems. Although, however, the period of time which will elapse before the sun has ceased to send forth its rays of heat and light, upon which undulations of heat and light all life on this earth is directly dependent for its maintenance, admits of rough calculation; we may infer that other factors may possibly, long before that time is reached, greatly modify the existing moving equilibrium of the solar system.

The question then arises—*Will these changes go on forever?*

CHAPTER II.

Has the Production of the Universe been Gradual or Spasmodic ?

IN dealing with the question of the mode of origin of the universe and its contents, both lifeless and living, we have to choose between two distinct hypotheses.

Either the different parts of it have been separately made, or they have arisen by insensible steps, through actions such as we think we can discern continually going on around us. Both theories equally imply a cause, so far as we are capable of judging, and the point at issue is how this inscrutable cause, which all are bound to acknowledge, has worked.

It is not a question of those numerous forms of belief variously known as theism, agnosticism, or atheism; but what we have to determine is purely and simply the nature of a process. Are we to look upon the results we see, the actions going on around, as being produced in the present by a kind of special human-like interference, or are we to regard them as the natural outcome of laws, fixed and defined? To the man who believes that the universe has been created by an Almighty Power, it is a question of the manner of working, or the method of procedure of that Power. To the agnostic, it is a question of the way in which he prefers to look upon the processes of nature. Are they uniform and connected as causes and effects, as antecedents and consequents; or are they without manifest order?

To the atheists (if there be any) the problem would perhaps present itself in a similar light.

To my mind the most rational interpretation is that the Almighty Power, of whom we can never hope to form any adequate and complete conception, has worked in an orderly and definite manner.

Whether it is presumptuous or not for those who have come to this conclusion to have done so, will best appear after the most complete study of nature, as presented to our consciousness; and whether or not we are justified in saying that, because we can trace an obvious and apparently necessary connection between antecedents and consequents, for this reason we infer that the Author of all things has

worked, and works, according to definite rules ; at any rate most of us will acknowledge, that such at least appears to be the case. It may safely be said, that the belief that each special event is directly and immediately under Divine guidance, and subject to the most arbitrary interference, is a primitive belief ; an idea which has been gradually losing its hold upon the most highly educated ; and one which, more certainly than the opposed conception of regularity of procedure, brings us to the unsatisfactory theory, that all that is wrong and bad and miserable, has been, and still is being directly sanctioned and ordained. It seems quite impossible to believe that each act of wickedness, and each state of unhappiness and pain, can be attributed to the influence of a Power, which is at the same time to be regarded as working only for good. If we say that these evils are inevitable, we impugn the omnipotence of the Creator and Designer. If we say that they are purposely inflicted, we detract from His goodness.

Such a state of things as exists would apparently rather accord with the existence of two mighty powers, the one using his influence for good and the other for evil, each being thought of as ordering events individually. The obvious reply to the above argument is, that even if we suppose the Godhead to have fixed and definite laws, in accordance with which all things have been produced, still we do not rid ourselves of contradictory implications, for the difficulty is only removed a few stages backwards.

The question would equally arise :—If an Omnipotent Power were working for good, whether according to law or irregularly, why should it have been necessary for organisms, including men, to go through so much suffering and pain ?

If we admit the existence of Supreme Power at all, the same reasoning would still drive us to the conclusion, that, granted there is good and evil to be discerned, two powers, the one good and the other evil, must be supposed to be accountable. Merely stating that the general belief found in almost all religions more or less distinctly accentuates this antagonism, we must dismiss this point ; at the same time expressing our idea that the belief in special interference and special creation appears to us so thoroughly anthropomorphic, that we prefer to accept the hypothesis of a gradual creation in obedience to fixed laws, though it is admitted fully and unreservedly that this latter theory by no means settles all doubts.

Of two kinds of belief, it seems distinctly preferable to accept that which is least objectionable.

There is no doubt, I think, that, after all, the best conclusion is, that whatever is, is right. In other words, the incidental pains and misfortunes to which we are subject are to be regarded as infinitesimal, compared with the good they will indirectly bring to the world at large.

We must all look forward more or less distinctly to an ideal state of society, to be reached not necessarily, but not improbably, on this earth, in the far-distant future, where joys are all in all, and sorrows cease. The pains and troubles and sufferings we are now bearing are the means by which alone this best state can come.

At any rate it is not only legitimate, but in the highest degree desirable, that we should always keep such a desirable consummation in view.

To continue, nearly all primitive notions are now discarded. No longer is it currently believed that the sun revolves round the earth.

In former times each natural phenomenon was looked upon as caused by a special personal agent, acting in a manner essentially human.

When man was in the habit of regarding himself as the centre of the universe, it was quite natural that he should consider each occurrence as due to the working of a being very like himself, acting in a human manner, and mainly at least with a view to man's personal benefit or disadvantage. Even now we have traces of such notions, for there are many, even in these days of enlightenment, who do not allow their consciousness of a Supreme Being wholly to remove the belief in charms, and in good and evil spirits, and ghosts, and death-wraiths. But let it be remarked that the refusal of the majority to believe that epidemics are punishments inflicted by an angry Deity, and their belief that sunshine and storm are not determined arbitrarily, does not detract from their belief in the power and goodness of the Supreme Being. In short, the early anthropomorphic conception of the Deity is quickly disappearing, to be replaced by one of far wider import and much greater truth.

We now begin to realise that a God known would be no God; and now that we are beginning to fully grasp that it is within our own power to a large extent to do good or to do evil, we also think far more highly of a God who is represented as working by more or less definite rules, than of one who was in past times portrayed exactly like a huge human being, with feelings, tastes, and prejudices very similar to, if not identical with, those whose dictates we ourselves so blindly and impetuously follow.

Is it not preferable to picture an Omnipotent Deity as having set to work a definite law of evolution, which will in His good time work out the best results, than to look upon Him as specially creating each particular imperfection of what certainly appears to be an exceedingly imperfect system?

Many of the provisions found in nature, for instance, the fact that man is liable to be subjected to great pain and death, as the result of the effects on his constitution of any one of the members of the two or three dozen species of parasites which are peculiar in infesting him, if looked upon as specially designed, would surely imply the most uncompromising malevolence.

On the other hand, the evolution hypothesis has arisen in times of comparative enlightenment, and among the most highly instructed classes. It has received the support of the most brilliant thinkers.

In former times men regarded different phenomena as in each case caused by an agency like themselves, while now we rather look upon them as the result of one general agency acting uniformly; and we must remember that the interpretation of phenomena, as resulting from evolution, has of late been showing itself independently in various fields of inquiry.

Now all these distinct inductions are being combined and blended into one. Among astronomers arose the idea that the solar system has been gradually evolved out of diffused matter.

Among geologists, it is held that the earth has *gradually* reached its present varied structure.

We know as an absolutely verifiable fact, that adult living forms have been *gradually* formed out of the most simple germs.

A tree differs from a seed in almost every conceivable characteristic, as for instance in bulk, structure, form, specific gravity, chemical composition; and yet the seed produces the tree by a gradual process of changes extending over but a few years.

A single cell becomes a man in a period of about twenty years. Surely, then, the stretch of imagination required is not so very great in understanding how under favourable conditions a cell might, in the course of untold millions of years, have given origin to the human race; and, if we admit this, cannot we go backwards still further, and suppose that the living cell itself, or the living organism itself, which in some cases is not even so far developed as to be a cell, might have arisen from inorganic inanimate material?

CHAPTER III.

General Sketch of the Process of Evolution.

ALL thought must depend upon certain ultimate conceptions as postulates, the truth of which we are compelled, provisionally at least, to admit before we can advance to, or enter upon, any consideration of the origin of things. Without discussing this question, let it be agreed that we must allow our primary ideas of time, space, matter, and force, to have some basis in reality.

Before we can begin to discuss evolution, as expressed above, we must demand some definite starting-point; and the datum we require is the presence at some time, in space, of matter (in some form), endowed with the property of mobility.

We say nothing of such questions as the durability of time, nor as to the limits, or absence of limits of, space. We may just remark, however, that it seems more philosophical to look upon time as never beginning and never ending, being eternal in fact, and upon space as limitless. Of course, neither the absence nor the presence of limitation, either of space or of time, is conceivable by us, but it is unquestionably better to adopt that of the two alternative evils, which seems the lesser.

The evolutionist, then, demands the presence of atoms, *i. e.* of minute particles of matter in space as his *ultima ratio*, his starting-point; and let it be agreed, as it must surely be by all, that the Unknown Cause of all things is here as elsewhere fully and entirely recognised as the Supreme Author.

The question arises:—What is meant by evolution? The evolutionists suppose that all things as they exist to-day are the direct results of change upon change, of cause following effect (the effect becoming likewise the cause of succeeding effects); and that this process of change has gone on, ever since the supposed pre-existing state of things, when the primeval minute particles of matter flitted about to and fro in limitless space.

Evolution, then, is a process of change, the character of which is determined by this law of causation, *viz.*:—that every process, every motion, every display of force of any kind, every action, is followed by a consequent effect.

It is a name given to express such a mode of change or motion. It is the name for the process or method by which results are produced. We must obviously then be extremely careful never to be betrayed into looking upon it as a cause, whether primary or ultimate.

It is not the cause, but the manner in which the Unknown Cause produces effects.

To put it as shortly and concisely as possible, we may say that the evolution theory simply expresses that all things have been brought to their present state, in accordance with the general rule that every cause has its effect.

Passing now from the primordial atoms in space, we come very gradually to the following successive stages, viz. the formation of nebulous masses and rings, of gaseous spheroids, of liquid spheroids, and finally to that of greater and smaller liquid spheroids, externally solidified to a greater or less extent.

Reminding us of the original gaseous matter, the atmospheres of the heavenly bodies remain. They are composed of gases, *i. e.* of elements that are gaseous at the particular temperature to which they are subjected.

The originally liquid state is illustrated by the fact that three fifths of the earth's surface is still covered with water.

The directions of motion or orbits of these spheroids would be manifestly determined in each case by the degrees of mutual attraction exerted between them. This is in accordance with what is called the force or law of universal attraction, in virtue of which all bodies tend incessantly to approach one another. It is a mutual action which all bodies exert upon one another, no matter how far distant apart they may be.

The law is "that the attraction between two material particles is directly proportional to the product of their masses, and inversely proportional to the squares of their distances asunder."

Terrestrial gravitation is merely a particular instance of this universal attraction.

Leaving aside the speculation of Laplace and Kant, respecting the throwing off of rings of vapour from the rotating spheres of cooling vapour, it is to be noted that the authors of 'The Unseen Universe' give a statement of the nebular hypothesis very similar to the one thus roughly sketched above. They hold that the original state of the visible universe was a diffused or chaotic state, in which the various particles were widely separated from one another. As they came together in accordance with the law of attrac-

tion, heat and visible motion would be manifested; and we may imagine that the cooling and necessarily revolving mass, about to become the sun, from time to time threw off certain parts of itself, which thereafter formed satellites or planetary attendants.

Sir W. Thomson maintains that the sun was produced, millions of years ago, by the falling together of its materials from a state of wide diffusion.* Similarly the earth was formed ages ago, at first being, like the sun, in a state of white heat. Things being on a much smaller scale, the earth cooled down long since, while the sun will not be reduced to the earth's temperature for millions of years to come. In the same way he considers our moon and all the other planets with their moons were formed, the meteoric showers and the comets (probably of meteoric composition), still existing to remind us of the probable former condition of all the other bodies of the solar system.

Great difficulties are of course sufficiently apparent in these accounts, but the general idea is probably a true one.

Coming now to the case of the earth, we should consider in detail, if we wished to interpret evolution fully, the various changes, astronomic and geological, through which it has passed, before arriving at its present configuration and structure.

We should find that, in the far-distant past, millions of years ago, the earth was composed of diffused gaseous matter; that this gaseous state was gradually more and more completely transformed into the liquid molten state, and that the more superficial and external portion of this liquid passed in turn into the solid state, thus forming the earth's solid crust.

We have good evidence for the supposition that in its interior the earth is still in a liquid molten state, the heat there being of a most intense character. It will suffice to mention (as supporting this view) the familiar instances of volcanic action and of hot springs, and the fact that as we descend into the interior of the earth the temperature gradually rises.

We should, in the next place, deliberate upon the method of origin of life, or rather of living things on our earth, and we should point out, how impossible it must have been, to say at any given time, during the gradual change from inorganic matter to living aggregates:—"Here is a living being which has this moment been produced." The probability is, as far as we can surmise, that such change must have been

* It seems to us that the various constellations must have been much more *gradually* formed than might appear to be indicated in this paragraph, in which we endeavour to express the views of Sir W. Thomson.

of an exceedingly gradual character. Life, as exhibited in the lowest living forms known to us, consists of little more than almost mechanical processes of absorption of nutriment, of ejection of the undigested, unaltered portions, and of multiplication either by fission, *i. e.* by simple division of one organism into two or more, or by gemmation, that is, the budding off of new individuals from the parent. There is little doubt that, as in the past, so also in the future, the microscope will continue to reveal to us even still simpler creatures than the lowest now known.

Death would be also a most important subject for discussion in this connection, since we have no reasons for supposing that the lowest organisms do usually, in the ordinary course of nature, die, in any true sense of that term. Death seems to become a distinct feature of life when exhibited by multicellular organisms. In the next place we should trace the gradual rise of higher and still higher organisms, pointing out how, during this process, the two great kingdoms of animals and plants have presumably originated from forms, which possess exclusively the essential characteristics of neither kingdom. The important effects produced by this evolutionary process, on the materials available for food and growth, in the case of each kingdom produced, would fittingly receive special mention and explanation; for instance, the parts played by the two gases carbonic anhydride and oxygen, respectively, in regard to animals and to plants.

As corroborating the view of a common origin of all living things, we should find in classifying organisms that a kind of tree of life, so to speak, would be constructed, provided with the minutest branches and ramifications, each branch and twig representing known groups of organic forms, and indicating the primordial kinship, in their connection with the common trunk, the parent stock.

In conclusion, we should find many other matters of the greatest interest and most profound significance, for instance, the ideas of uniformity and multiformity, and the processes of integration and differentiation, as characterising organisms.

As the best instance of an integrating link between the different parts of the same organism, the nervous system which comprises the organs of consciousness, and provides for the maintenance of the internal relations of parts, might be profitably discussed.

In order to complete our sketch of evolution, we should have to consider also the possible future of the inhabitants

of this earth, and to discuss in what particular directions and ways men may hope to make appreciable advances. The probable end of the earth, in the far-distant future, would, in addition, require mention, as also would the question of the evolution of other systems of constellations.

Lastly, we should come to the great question of all:

“What can be the real nature of such an interminable series of illimitable and infinite changes?”

CHAPTER IV.

Organic Evolution.—Origin of Life.—Some direct evidence for Organic Evolution.

HAVING now cursorily considered evolution as a whole, let us glance briefly at the part of this process, which deals with the wonderful changes which constitute life. Firstly, then, the question arises:—How did life first begin? By what means are we to suppose that any transformation of lifeless into living matter could have been brought about? To this problem, it is to be feared, no thoroughly satisfactory solution can be found. True, it has been suggested, apparently almost as it were in jest, that living beings of an exceedingly low state of organisation, or the germs of them, may have been conveyed to the earth on which we live, from other planets by the medium of meteorites. Even if this were known to be the case, we should not be very greatly aided in our attempts to solve the mystery of vitality; for obviously the question would at once arise:—“How then did living beings first arise in this other planet?” Thus on and on the same barrier to the progress of our inquiry would rear itself up before us. At present, however, we are not possessed of any trustworthy or conclusive evidence, which would go to prove that life in any shape or form, as we know it, does exist at all in other planets. It may be so; but we cannot infer with any degree of real probability that it is so, in the present state of our knowledge. It is possible, however, that strange creatures adapted to environments, which differ greatly from our own, do exist in some at least.

Suffice it to say, however, that the difficulties presented by the supposed origin of life on the globe from inorganic matter, need not be thought a serious obstacle to our belief in the gradual change of lifeless into living aggregates. If we are prepared to admit, as I think we may fairly, that man and all other animals, in common with plants, have been gradually produced from the lowest organisms, during the course of untold millions of years, we can easily go a step further, and imagine that the lowest organisms themselves, which, be it remembered, are neither animals nor plants, were also in turn produced from some kind of colloidal protoplasmic matter; the formation of which resulted in consequence of conditions, at that particular time existing. Of course it will be obvious, too, that this supposed primeval life-producing substance ought to be in its turn traced back to the simplest forms of matter known to us. This supposition concerning the genesis of living things, does not, of course, commit us to any belief that organisms, even of the simplest kind, are *now* thus generated, just as indeed we do not think that apes are *now* in process of giving rise to human beings. Indeed, an acceptance of spontaneous generation is, in the light of modern science, most distinctly unjustifiable.

Lest it should be thought that those who hold the doctrine of evolution are necessarily bound to believe that man is directly descended from apes or ape-like ancestors, let it be distinctly understood that the evolutionist would rather maintain that both apes, as we now know them, and man, as he now exists, have originated from a common source. With regard to the gradual change from lifeless to living material, it must also be remembered that some of the lowest organisms can scarcely be said to live, in the ordinary sense in which that word is understood; inasmuch as they do little more than take in, and throw out, extraneous materials, react in a simple manner to external stimuli, and split from time to time into two or more portions, each of which forthwith assumes an independent existence.

Such phenomena are so remote from what we ordinarily understand as implied in the term *life*, though it is true they gradually blend into the more vital processes of higher forms, that it seems necessary to note that the difference, though one of degree only, is still one of great moment. Let us now consider briefly some of the direct evidence, which may be alleged as supporting the belief, that all living things have had a common origin. We know that no two individuals even of the same family are exactly alike,

that frequently they differ greatly, and that, after two or more generations, the unlikenesses of structure often become extremely marked.

In the results of breeding, we have ample evidence that by artificial means, such tendencies can be intensified to a marked extent. In millions of years, then, under the very varied conditions which geological records imply, it is conceivable that almost any amount of change might have been produced.

The domesticated animals and plants show us how races can be modified by artificial selection; how, by selective breeding, various animals and plants have, so to speak, been moulded by man to his use; the means adopted being long-continued using of those particular animals for breeding purposes, which possess the slight but important variations, capable of being readily distinguished by the experienced eye.

Now, if we substitute in our minds, for the art of the breeder, that natural selection which is ensured by the struggle for life, it will be obvious that, as the less favoured individuals succumb, survival of the fittest results. The rivalry between competing organisms is necessarily more severe, the more nearly alike the different individuals are; because, the closer the relationship, the more nearly do they agree in their requirements. We may assume then, that the modified descendants of any one species will succeed so much the better, as they become the more diversified in structure; and are thus enabled to encroach on places, occupied by other beings.

Now, survival of the fittest of course involves the extinction of the weakest and most inferior; and, as diversity would give the better hopes of success in life to a larger number of organisms, there is a tendency for those characterised by variational extremes, to survive at the expense of the less divergent varieties. Hence is brought about the multifarious character of organisms.

Very many more young creatures are annually produced, than can possibly survive. Thus arises the struggle for existence.

The changing conditions of the environment must produce corresponding changes in the structures and functions of organisms; and there is supplied in the variability of species a safety-valve, by which organisms which can most completely adapt themselves to the changed conditions, are far more likely to survive and prosper, than others less favoured, and less capable.

The offspring, to which these changed organisms give rise, exhibit, at least, corresponding changes, owing to the law of heredity that "like produces like," while in many cases they doubtless tend still more to perfect their adaptability. We have, then, to bear in mind the immense rate of increase of organisms, which leads to the keenness of the struggle for life; the marked tendency which organisms display to individual variability, owing to the character of the particular conditions to which they are subjected; and also that external conditions vary incessantly and to a great extent, producing corresponding changes in living things.

Such, in brief, is the theory of natural selection advanced by Darwin to account for the origin of species.

The arguments for organic evolution have been specially insisted upon, and elucidated by, Mr. Darwin, whose researches and writings are generally said to have completely altered the character of human conceptions, concerning the parts played by living forms in nature.

Of the arguments from embryology or development of the individual, first in order of importance comes Von Baer's induction.

"In its earliest stage, every organism has the greatest number of characters in common with all other organisms in their earliest stages; at a stage somewhat later, its structure is like that displayed at corresponding phases by a less extensive multitude of organisms; at each subsequent stage, traits are acquired which successively distinguish the developing embryo, from groups of embryos which it previously resembled; thus step by step diminishing the groups of embryos which it still resembles; while the similar forms are narrowed successively to the class, the genus, the species, and the variety of which it is a member, until at length individual characteristics are developed."

Since the time of the illustrious Von Baer, the researches of subsequent embryologists have still more clearly established the truth of this induction. In the course, then, of its development, an animal passes through stages, the earlier of which approximate it to the lowest types, while, by the later changes, it successively approaches in character types of increasing specialisation; until at length the adult animal acquires all the characters of the species and variety to which it belongs, and finally takes on its individual traits. For instance, we know that a human being, during a certain phase of its development, is possessed of gill-slits, and bronchial arteries in many respects similar to those of an adult fish; and that in later stages, the presence of a tail

and of a hairy covering, indicates that men and apes probably had in the far-gone past a common ancestry.

This parallel between ontogeny, the development of the individual in the present, on the one hand, and phylogeny, the supposed origin of the tribe in the past, on the other, indicates that primordial kinship of all organisms, which, having regard to the facts at their disposal, scientific evolutionists infer.

Of the arguments which can be adduced from a consideration of the morphology of adult organisms, the following stand out prominently, as suggestive of evolution.

The strongly-marked affinities, which exist between the lowest members of groups, represent that kinship which the hypothesis would imply. For instance, the very lowest organisms known to us cannot be designated either plants or animals, since they present some of the characteristic properties of both kingdoms. Again, the striking feature of marked unity with extreme multiformity, which organisms so strikingly display, points almost unmistakeably to connection by descent, that is to evolution.

The unity of type which is so often apparent, even under extreme dissimilarities of form and mode of life, is one of the most notable facts in morphology. Again, the likenesses disguised by superficial distinguishing marks among various organs in the same organism, are worthy of minute attention, implying, as they do most certainly, that similarity of plan on which they have been constructed.

We remark, then, that animals, and indeed all organisms, appear to have been built on similar principles throughout their whole structure; and also that a consideration of the different parts of the same animal or plant would likewise favour this idea of unity of type.

Now that the cellular constitution of every tissue of both plants and animals is thoroughly established; now that we know that the primary elements of all the tissues and organs are cells; nay more, now that we know that the constitution of the cell or vesicle is in all cases strikingly similar, we may with justice lay the very strongest emphasis on this idea of a uniform plan of organisation seen throughout the living world.

The idea that the skull is but a modified portion of the anterior end of the vertebral column, exemplifies that particular form of unity of type, which is known as serial homology or longitudinal integration, so well seen in the members of the Class, Arthropoda.

The presence of the vertebral column throughout the

higher Vertebrata, and of its representative, the notochord or *chorda dorsalis*, in the Tunicata, affords another example.

In short, it may be said that the combination of unity with multiformity is perhaps the most striking and characteristic feature of nature, throughout her numerous and varied aspects.

Further, the presence, in all kinds of animals and plants, of utterly useless, nay even destructive, parts, indubitably points to community of descent; for, only when thus interpreted and explained, have they any clear meaning. As an instance of such rudimentary structures, may be mentioned the vermiform appendix of man; of which it is to be remarked not only that it is a useless prolongation of the colon, subserving no good purpose whatever, but that it is not unfrequently the cause of death, by means of the accidental entry into it of cherry-stones or other small bodies, and consequent abdominal disturbance.

With regard to the evidence to be drawn from a study of palæontology, it may be said that there is to be discovered a general relation between lapse of time and divergence of living forms; and that the permanent disappearance of species, of genera, and of orders, also favours the idea of evolution, as does also the connection between the present and past forms, to be found in each great geographical region.

We have, moreover, in some cases, clearly demonstrated histories of very great modifications of structure and form, for instance in that of the horse.

We find that, the greater the period of time which has elapsed between any two given stages in the history of a group, the more marked is the difference between the organisation of its members at each of the two periods.

It is also noteworthy that species, genera, and orders, which we know to have existed in past times by the study of geological records, are no longer represented on the earth's surface. This is to be explained by the supposition that, being unfitted for their environment, and the conditions to which they were subjected, they succumbed, giving place to superior competitors in the struggle of life.

Again, we see that, having regard to the great similarities between the fauna and flora, which inhabit any given region at the present time, and those which geology tells us inhabited it in past times, there is the greatest possible probability that the latter animals and plants have descended directly from the earlier. At the same time we know that there are appreciable differences to be observed.

That is, while we can trace a general connection in structure and organisation between the organisms now existing in any one region at the present time, and those which inhabited it formerly; still there are great and marked differences between the modern and ancient groups, thus indicating that a considerable amount of modification has been gradually produced.

From the study of distribution in space, we learn that there are remarkable identities of type to be discerned between organisms inhabiting one medium, and strangely modified organisms inhabiting another, and this points to community of descent.

We shall, then, be the more prepared to accept the idea of organic evolution, always with the reservation heretofore insisted upon, viz. that any human explanation of things must necessarily be tentative and provisional, when we realise that it is the only practicable rationale which presents itself to the student of organic forms. That theory or belief which is called Darwinism, or Natural Selection, is, after all, but an extension of ordinary methods of reasoning to facts where the application is, at first sight, of necessity obscure. The law of causation, first recognised where its operation is most obvious, has at length been traced into the regions of greatest doubt and mystery, viz. the sphere of vitality; and, if it is not manifestly in perfect accord with all the observed facts, if its working seems to be strange at all times, and sometimes lacking in uniformity and consistency, still the closest examination will invariably reveal that what of life is inextricably involved in the folds of the inexplicable is in reality scarcely of less magnitude than are the almost hopelessly inscrutable mysteries presented by other portions of the universe. The various processes of living organisms are no doubt, at first sight, apparently more mysterious than are the ordinary phenomena presented on all sides to our consciousness; but it is very questionable if the duly regulated motions of the heavenly bodies, each of which is in itself a mystery of mysteries as yet far from solved, is one whit less wonderful than the conscious existence of any one of us. Be this as it may, it must be confessed, for it certainly cannot be denied, that the systematic explanation of all things according to the idea of evolution, *i.e.* according to the universal law of causation, is a great gain, an almost inestimable advance in our methods of reasoning, as compared with the older and more erratic conceptions of the parts played by organisms. One step more, in quite recent times, has been, and is now being, taken. To the man of

thought it will be readily obvious that, since those changes in organisms which are called abnormal and pathological are in reality to be classed as part and parcel of the sum total of processes displayed by them, they must have, and indeed can have no other than, a similar relative explanation. Hence, the idea of evolution in pathology is in reality not only to be accepted in itself as unquestionably a true and indisputable one, but is rather, as we shall hope to show, to be accounted one of the supports and stays of evolution at large as an indubitable fact.

CHAPTER V.

*The Nervous System.**

BEFORE proceeding to our remarks on Evolution in Pathology, let us consider very briefly to what extent the same theory is applicable to the features of the nervous system, with the view of exemplifying, were it ever so dimly, how our ideas of the various structures and functions of organisms may receive elucidation from an acceptance of the idea of gradual growth in obedience to, or rather as a result of, natural processes, going on in accordance with what may be called the law of causation.

We have only to consider for a moment in what essential respects a civilised man differs from a savage in order thoroughly to realise the paramount importance of an acquaintance with the working of the nervous system, and that of the mental faculties in particular; inasmuch as it is purely and simply in the greater excellence of them, that the superiority of the former over the latter is made manifest. Just as the higher animals differ from the lower in their greater adaptability to external forces, so do the civilised differ from the savage; so do the educated differ from those who have not been trained; so will the man of the future differ from his representative of to-day. There can be but little doubt that a gradual improvement in the average mental powers of mankind is comparatively rapidly

* Some of the ideas and statements contained in this chapter and in others have been gathered here and there from Mr. Herbert Spencer's invaluable and most interesting works.

taking place ; while we have also reasons for believing that the inexorable law of the survival of the fittest which is, in this age, attended with such deplorable results, as are testified by the crowding of our prisons and asylums, will, when a knowledge of elementary physiological facts and principles is more general among us, be at least not so painfully apparent. There are, moreover, those who, while predicting the steady continuation of that advance which has already been so far made, can see in the history of the past, as in a mirror, a dim representation of what the future may be.

The nervous system is, perhaps, the highest and most complex point of view from which life can be regarded, leading as it does to the consideration of all the deepest truths of consciousness, of intelligence, of volition, of free will, and reaching its highest development in man himself ; thus enabling him to illumine, with the additional lustre of thought, all that he sees of the beautiful, the wondrous, and the marvellous among the many mysteries of the universe.

In dealing with the nervous system, one important source of error should not be overlooked. In the process of our investigation we must never forget that we necessarily employ the very thing investigated. It is obvious that when we think about our brains, we use our brains. Both for this reason, and because we presume that by a gradual series of changes following changes connected as causes and effects, the simple nervous properties exhibited by the lowest animals have been transformed into the highly perfected nervous system of man, we must endeavour to trace the connection between the two extreme stages. It is manifest that in order to learn anything thoroughly it is absolutely necessary to begin at the very beginning. We will therefore proceed shortly to discuss one of the very lowest animals, for in them, as in all vegetables, and in those organisms which are neither animals nor plants—the *Labyrinthuliæ* and the *Myxomycetes*, for example—no nervous system has as yet been traced.

The *Amœba* is one of the simplest microscopic animals known to us. It is almost wholly composed of the same living matter throughout its entire substance, with the exceptions that in the interior is a portion harder than the rest, called the nucleus, and that the external or superficial part of it, the part which is most exposed, is also harder and more solid. Thus we have a division recognised between the external part or *ectosarc*, and the internal part or *endo-*

sarc. The *Amœba* is continually changing its shape and position. It eats by simply flowing around its food, and having incorporated into its own substance what is useful, it flows away from the useless remnant. Thus it lives, moves, eats, grows, reproduces itself by dividing into two, and possibly never dies (in any exact sense of that word).

When disturbed, for instance, by contact with a foreign body, it moves, and it is peculiar about the movement that it is far greater in amount than that which would occur in a portion of non-living matter, which had been acted upon by the same amount of force.

In fact, an inanimate object is affected by external forces in such a way that a direct and exact relation can be traced between the degree of external force at work and the amount of motion produced; while in the case of a living being no such exact correspondence can be seen. The movement may be greater or less, according to circumstances; and it is impossible to predict in what particular direction it will tend. There seems to be a large quantity of pent-up energy in living beings.

Again the *Amœba* is seldom at rest, and, since the changes in form and position which it undergoes from time to time cannot be explained as entirely and directly attributable to events which take place near it, but are also in great part due to chemical and physical changes, which occur within its own substance, we may speak of it in this sense, and in this sense only, as automatic. Any higher animal may be looked upon as composed of innumerable cells, each similar to an *Amœba*. These cells are arranged into groups called tissues, and there is a division of labour to be perceived among these groups of cells, so that some discharge one duty, and others another.

Thus we have muscular, nervous, and numerous other tissues and organs. At the same time, however, we must remember that as well as becoming distinct and different, the tissues and other structures also become more and more intimately allied. The chief connecting links are found, firstly, in the circulatory system, by which blood is supplied to all parts, and secondly, in the nervous system, which ensures the due interchange of energy.

Comparing, then, the nervous arrangements in the *Amœba* with those in man, we find that, while in the former every part of the body has the same powers and properties, in a higher animal the actions which we class as nervous, are confined chiefly to a central mass of irritable nervous matter. From this, and to it, proceed what are called nerves, some

of which bring sensations to it, while others take away commands from it to the muscles, and to all the other parts of the body.

“In the higher animals,” says Dr. Michael Foster, “the simple automatism of the *Amœba* is replaced by an exceedingly complex volition, affected in multitudinous ways from the world without.” The nervous system in them presents a complex, varied, and definite structure, of a peculiar kind.

In order to illustrate the connection which exists between the different parts of the body, let us reflect what would happen in a community if the highly cultured, who, by their sedentary habits, have in many cases become in some degree unfitted for the performance of the more active measures necessary for the acquisition of food, were suddenly deprived of the aid afforded them in this respect by the working classes.

Or again, what would become of the employed were there no employers?

Just as, then, in a society the increasing division of labour, which goes on in an increasing ratio, while it facilitates the progress of the community, at the same time renders all sections mutually dependent in a marked degree; so in an animal, the higher its organisation becomes, the greater becomes the connection of the increasingly different parts.

As an old story reminds us, should any portion of the body, resisting the influence exercised over it by the brain, rebel, it could doubtless cause the death of the entire animal; but let it remember that its own existence also would be at an end. That this connection between the welfare of the different parts is well known is shown by the fact that, when people are particularly anxious to gain a great favour from anyone, they are not in the habit of pursuing the object of their search when he is just on the point of dining, but invariably postpone their application to a more suitable time, when, providing his digestion is not impaired, it is to be presumed he is most likely to view his fellow-creatures with favour and benignity.

This mutual dependence of the body at large on that of any part, such as the nervous system, and the equally conspicuous converse relation, are facts of the greatest importance.

As important as is the brain to the body, which is governed by it, so necessary is the ruling power to the life of a nation; and just as misplaced as would be jealousy on the part of the organs of the body concerning the brain, so

absurd would be envy concerning the few in a nation, who, by reason of their talents, have secured the highest positions, on the part of the many not similarly endowed.

In what essential property or properties do the nervous manifestations of mankind differ from those exhibited by lower animals?

No one who has observed it can fail to have been struck with the fact, that an ostrich can almost keep pace with a railway train.

Now, the lowest animal differs from the highest mainly in the fact that it cannot move from place to place so rapidly. The movements of those small living things which can be seen flitting across the field of the microscope, are manifestly quite inappreciable when compared with those of a mammal, which gallops a mile in a minute.

Though great power of motion can only be displayed where the whole organisation of the body is highly perfected, it chiefly depends on the muscular and nervous systems, and the latter of these, the nervous system, may be said to be the primary generator of motion.

Throughout the animal kingdom, the amount of motion produced is fundamentally related to the degree of nervous development. This relation is even seen between the active and inactive stages of the same individual; for, while the feebly-moving caterpillar has but a small nervous system, in the pupa-stage a rapid growth of it may be traced, ending in that of the butterfly, which has it relatively large.

Again, while the amount of muscular tissue relatively to the total bodily weight is about the same in fishes, in reptiles, in birds, and in mammals, we find that the nervous tissue increases in amount, as we ascend the scale of life, and, speaking generally, the amount of motion expended increases in about the same proportion.

The relation between degree of nervous development and amount of motion expended, is, at first sight, not an exact one. For instance, a horse gallops far more rapidly than a man can run, and daily moves his body more than a man does. Yet while the brain and spinal cord of a man weigh about 3 or 4 lbs., those of a horse weigh only 2 lbs.

In order to explain such apparent anomalies, we must remember that the higher animals perform actions which are more numerous in kind, and of a far more involved nature.

Again, the brain and spinal cord of a man are twice as heavy as those of a gorilla, which, while moving about

among the trees, generates daily more motion than an ordinary man. We find, however, that in animals which generate the largest amount of heterogeneous motion, as in the case of man, the largest nervous system exists. It must be borne in mind that all the actions of all living beings are known to us only as motions.

Even those changes of the countenance, even those variations of intonation on which we put so much meaning, the most brilliant thoughts of the greatest thinkers, those acts of heroism and devotion which all the world applauds, are, when reduced to their lowest terms, as far as we can judge, nothing more than forms of motion; and one of the primary truths respecting the nervous system is, that there is always a direct relation to be observed between the degree of nervous development on the one hand, and the quantity and heterogeneity of the motion produced on the other.

Speaking of the whole animal kingdom, we may say that increase in degree of perfection of the nervous system is always exhibited in two ways, viz. in increase of size, and in greater combination of parts.

Among vertebrate animals (popularly known as those which possess a backbone) the lowest, the *Amphioxus*, possesses a simple rod of nervous matter, with the foremost portion enlarged, and thus representing a brain.

In fishes, we observe that the enlarged portion is transformed into distinct pairs of masses, and that some of these masses of nervous matter gradually become larger, and overlap the parts in front. In man one pair called the cerebral hemispheres, generally known as the greater brain, has become so enlarged, and overlaps the portions in front of it to so great an extent, that the latter are not visible, except by dissection.

Increased union of parts and increase of size are *the* features which are most conspicuous when we compare the highest form of brain with the lowest.

In man the surface of the brain exhibits numerous remarkable folds, which are called convolutions; and it is to be noted that in one of them, in the left inferior frontal convolution, M. Paul Broca has discovered the seat of language. In this connection it seems not misplaced to say a word against the so-called knowledge of so-called phrenologists. In the opinion of physiologists the arbitrary and empirical mapping-out of the brain into centres of emotion, or whatever they may be termed, is the most arrant fraud and deception which has ever been palmed off on an unsuspecting public. Though something

has been done on the subject of cerebral localisation by Ferrier and others, and though much more could be done, if those who think themselves philanthropists would not interfere with scientific research, nothing even approaching in exactness to the barefaced empiricism of phrenology, has as yet been found possible.

In short, the subject of cerebral localisation presents far greater difficulties than can even be imagined by those who have not seriously and systematically studied the nervous system. By far the most important method by which our knowledge of it, as of all other vital processes, can be advanced, is that of vivisection.

The tirade against this mode of investigation has displayed a degree of unwarranted and vehement opposition almost unknown even in these days of misplaced zeal, and it has already done much, and is likely to do far more, unless checked, to prevent the progress of knowledge. In the *Nineteenth Century* of March, 1884, Mr. H. D. Traill gives an amusing illustration. In it the rabbit is appealed to by the fox in support of his views of the hardships inflicted by man on the lower animals. To the questions put to him by the fox, "What do *you* think of cutting rabbits up alive, eh, Bunny?"—he replied,—“I don't know; don't ask me; it's bad, very bad; but—but my mother's hind leg was broken with a shot yesterday, and she has just crawled home. She's lying over there behind the hedge, I'm not sure shooting ain't worse than the other.”

It does certainly seem a very strange instance of erroneous judgment that the small amount of pain which is so greatly lessened by anæsthetics and other expedients, that in the majority of cases it is almost *nil*, which moreover has been the means of aiding to so large an extent, and would so much further facilitate the progress of scientific knowledge, and our means of combating human disease and misery, should be so unduly, so vehemently, so energetically, attacked and condemned.

Again, the amount of pain capable of being felt by the lower animals cannot be judged by our standards, and it is possible we greatly over-estimate it. We need only contrast the highly sensitive blood-horse with the heavy and lethargic cart-horse, to realize what a difference in the amount of sensitivity to pain there exists, between higher and lower animals, even of the same stock.

There are two more points relating to the nervous system, which it is proposed to mention briefly:—

(1) What really happens when we think?

(2) What is the chief obstacle to an increase in the perfection of the nervous system?

With regard to the first very significant and interesting question, we have a shrewd general idea; but, at present, this is all. A complete explanation is quite impossible. In the case of a muscle, the chemical changes are so conspicuous, that we have no hesitation in saying that they are directly related to the contractions, and there can be no doubt that such is the case also respecting the working of the nervous system. As yet, however, our knowledge of the chemistry of the subject is of the scantiest, and mainly relates to the central nervous organs only. We find that the oxygen contained in fresh air is very necessary for the maintenance of irritability in them, and thus we have an argument not generally adduced for insisting on the paramount importance of good ventilation.

People smile when we speak of that future man, who is to be so much nearer perfection than we are, and in his interesting work entitled 'The Coming Race,' Lord Lytton depicts in the most brilliant manner some of the many difficulties and inconsistencies which might be supposed to make any great advance impracticable and improbable. To these another may be added.

Animals possess in a high degree a certain instability of chemical composition, which enables them to act as automatic agents. The chemical characters of the matter of which organisms are composed are such as to adapt them in a high degree for those various and rapid changes which constitute life.

We have reached a certain stage of more or less stable equilibrium, and there are reasons for thinking that in the future the equilibrium reached will be far more stable, as well as more perfect in other respects.

We must, however, remember that those peculiar changes which constitute life are only rendered possible by the formation of an aggregation of matter, which is in a very high degree sensitive to the actions of external forces, and these, being necessarily adverse, are always liable to overthrow the vital powers. Hence the great liability nearly all living things display to decay and die.

Further, the more perfect an animal becomes, in proportion as it becomes more sensitive to external forces, and therefore higher, just in the same proportion does it become more difficult for this great sensitivity to be properly and adequately counterbalanced by greater stability.

The great sensitivity required is itself the very obstacle

to its own increase, inasmuch as it most easily succumbs to adverse conditions.

Therefore it happens that those who tax their mental powers unduly, frequently become inhabitants of madhouses. The current statement that "much learning hath made him mad," expresses this idea.

It is thus of the very greatest importance that we should never lose sight of the fact, that the highest ideal of a nervous system is not one which has been developed to the extreme point of human endurance, but that state of mind and body in stable equilibrium, the "*mens sana in corpore sano*." This is what we should always strive to produce in the young. If we bear this in mind we shall be on our guard against all tendencies to what is generally termed *cramming*, though, it may be remarked, even this horrible process has not been without influential advocates.

The best educational regulations are framed, as they should be, with the express view of producing a class of men capable of doing original work, rather than a class fully imbued with all the details of past work, much of it most erroneous and misleading.

Initiators, rather than imitators, always receive in the battle of life the highest rewards; and any system of examination which places a higher value on imitation can fortunately only last for a time.

CHAPTER VI.

Some Remarks on Pathology, treated from the aspect of Evolution.

[Taken mainly from a pamphlet entitled 'Some Pathological Bearings of Darwinism,' by Dr. D. Astley Gresswell, B.M., B.A., Christ Church, Oxford, M.R.C.S., Fellow of the Royal Medical and Chirurgical Society, recently Medical Inspector under the Local Government Board, Author of a 'Report on some Organic Phenomena in their Relation to Changes of Environment observed during a Voyage round the World in a Sailing Ship,' &c.]

A question we have set ourselves to decide, or rather to examine, is whether all the processes which make up life in its varied forms and phases are to be considered as connected,

by some kind of causation, not only with the phenomena occurring in the environment, but also one with another in very many instances. This is obviously a very large question, and may be looked at from very many distinct points of view. Now we are about to deal rather with those functions and structures which may be considered as abnormal. We shall endeavour to point out instances of such great and striking similarity that the only apparent and, indeed, thinkable explanation is that of causation, or, as we may prefer to call it, of evolution. All we hope to do is to trace connection in cases where it is at first sight obscure. Though we can to a large extent say definitely, of any given structure or any given function, that it is a normal one on the one hand or an abnormal one on the other, yet it is obvious that in many cases it is extremely difficult to draw the line of demarcation. This being the case, as indeed is only to be expected, we see still more clearly that the law of causation, which we suppose to apply to the one series of actions, applies equally forcibly to the other. If a structure is disordered, or a function vitiated or altered in any way, it is clear there must always be a cause, could we trace it, for the resulting change. Perhaps the cause may be exceedingly obscure. We may have to look back to a far-distant time and a progenitor which lived long ago. Still, the cause, we must suppose, has existed in some form, at some time.

Are there reasons for concluding that human pathology is related to that of other animals, just as other human characteristics, both structural and functional, are indubitably related to those of lower organisms? Certainly, such reasons can be found, and though as yet pathology has scarcely been more than glanced at from this point of view, though general or comparative pathology has only recently been recognised as a science, still even now the evidence at our disposal is so strong as to render our conclusions at once emphatic and wide. Indeed, when we consider the *à priori* plausibility of this particular aspect of the general question of evolution, we can only be struck by the fact that men have been so slow to realise that pathology must advance as all other sciences have advanced, viz. by comparison, and that even in these days the idea is not more extensively grasped, and more completely worked out. Just as all other knowledge is relative, and rests purely on comparative landmarks, so also is pathology to be considered and examined by means of comparing one series of processes and structures and factors with other series or sets of structures and functions and factors. It will only be when men have learned

to understand fully the immense and incalculable advantages, to be derived from studying the diseases of mankind, by the light thrown upon them by the normal and abnormal processes of lower animals, that pathologists will be enabled to take clearly, decisively, and in earnest those immense strides we can foresee not far off. Now that some are beginning to track out the new paths, now that Pasteur and Lister and Klein are leaders into new and fertile regions, now is the time for earnest and energetic workers imbued with the same ideas of progress and advance.

Thus it will be evident that the immense utility of veterinary science will be, in the not distant future, far more great than it has been in the past. When the immense stores of knowledge open to us are rendered more and more accurate, and when the sources of observation and inquiry are rendered far more available to the world at large and to the scientific world in particular, more free and more open to the cultivated investigator, then those who look for, and long for, more light on many abstruse and difficult problems, will have, indeed, fruitful opportunities held out to them, and thus reveal much of what is now hidden away out of sight. We are now living in times of transition, in times when many of our old ideas of the processes of life, whether normal or disordered, are liable to be—nay, will probably be—revolutionised. A great deal is being done to clear up the mysteries of life, disease, and death. Now at length we are beginning to see things in their true light, and to acknowledge that gradual growth, and necessary and inevitable connection and causation, are watchwords of the very highest moment.

As we have intimated above, we must always remember, in dealing with any one of the higher animals, that they may be considered as being composed of an almost infinite number of cells, which have been variously modified in all kinds of ways and degrees, modified in correspondence with, and in order to meet, as it were, the many different requirements of higher or more complex conditions. We cannot entirely explain the marvellous manner in which such effects are brought about; but we can, at least, lessen greatly the difficulties which at first sight most gravely impress us. The higher an organism is, the greater and the more intimate is the combination of the most divergent parts. These are united in numerous ways, and when thus united they are, moreover, still more wonderfully blended by connecting links of other kinds. Thus it comes about that in trying to explain living processes, whether normal or abnormal, we

must bear in mind that there is always a tendency for the constituent portions of higher organisms to dispense in a greater or less degree with the combining bonds, however well-knit together the parts may be. Moreover, there is the still greater danger always to be apprehended that the bonds themselves, of which the chief are the vascular and the nervous mechanisms, may be more or less completely rent asunder in any particular part, or in many different ways interfered with in regard to their efficiency.

The observations which follow are, for the chief part, taken from the pamphlet previously referred to, by Dr. D. Astley Gresswell, B.M., B.A.

I.—SOME ABNORMAL STRUCTURAL MANIFESTATIONS OF EVOLUTION. PHASES OF NUTRITION.

Among plants and animals it is found generally that most of the carbohydrates are convertible into one another, that fats and some of the carbo-hydrates are mutually convertible, and that albuminates are capable of being split up into fat and other bodies. Albuminous infiltration is common in low life, and it occurs normally in the higher organisms. Albuminous infiltration, fatty infiltration, fatty and pigmentary degeneration are all phases of nutrition manifested both in the life-history of a higher organism, and also in the lowest organisms as physiological events, and they occur also as pathological, abnormal, or reversional phenomena in the higher organisms, and probably in those which are lower in the scale. Again, if we stimulate, or give an extra supply of food to, low forms of life, they grow and multiply more rapidly. The same is seen in the case of endothelium, when it is stimulated and so made to germinate, and also in the cells contained in the capsules of cartilage, when it is subjected to cauterisation (Kremansky). Stricker asserts that every living cell in the higher animals may divide, and Dr. L. Beale maintains that pus-cells may develop from bioplasm of any part of the body, when too freely supplied with pabulum.

Such processes, when occurring in higher organisms are called inflammatory; but they do not differ in essential characters from those which take place in lower organisms under similar circumstances. As a matter of fact, the processes we call inflammatory, when manifested by the avascular structures of higher animals, being in great measure the expressions of greater nutritive activity, are, without doubt, represented in low life by the phenomena of rapid growth. This is evidenced by the karyokinetic phenomena presented

by an inflamed cornea, multiplication being nutrition carried beyond the limits of the individual. Again, the cells which result from inflammation are certainly fitted for but little more than the carrying out of their own ends, just as, when a low organism similarly divides into two or more, each goes adrift about its own business, all cohesion being lost. There are, however, in inflammation other factors which lend great complexity to the process. The migrating cells are more active, and, in vascular tissues, stasis of the circulation and accumulation of leucocytes and ozone-bearing corpuscles are also prominent features.

New Formations.—It may be said that all new formations, as instances of which the Enchondromata may be here mentioned, are characterised by the preponderance of cellular elements. These are, of course, variously modified. They may fibrillate, and may also even calcify; but very rarely, if ever, do they develop into the highest forms of tissue, the muscular and the nervous (Buhl). This latter fact is only to be expected, since the tissues of most important specialisation must necessarily be those which are produced, so to speak, with greatest difficulty. We have pointed out above, and with some emphasis, that practically all the tissues of all organisms, including the highest, have been proved to be so much like the modified results of primitive cells, more or less intimately blended, as to be supposed to have indubitably arisen from them in the first instance. Similarly also, new formations in animals are, without doubt, traceable to the proliferation, the abundant growth of the same units, viz. cells. The units may be less or more modified, or, indeed, they may be apparently almost indistinguishable from those parent cells which originally gave them birth.

New formations of whatever kind are, we maintain, to be looked upon as reversionary in character. In other words, they point clearly to a remote ancestral condition, when the primary importance of cells as units not greatly modified, distinct and uncombined into aggregates, or but imperfectly and incompletely combined, was far greater in respect of individual power than it can be, where each cell is dependent on the activities of other units with which it is combined, as in higher forms of life.

In this connection we do not propose to discuss the many conditions which may bring about the growth of new formations. This subject of inquiry, viewed from this aspect, is a fertile and rich field for the investigators of this age. Already a great deal has been done; but all that has been as

yet achieved and discovered is very microscopic, compared with what our successors will know as to the intricate factors of disease. New formations may be excited into being by Schizomycetes or other parasites, or—and this aspect of the question is most important,—the inability on the part of the original cells from which the new growths have arisen to differentiate and perform their ordinary functions in the normal way, may result from other factors, which in the present state of pathology we cannot trace.

In all cases of new formations the end-result is due to a cytodic or cellular growth which can only be looked upon as implying the survival of functions formerly performed by their antecedents. Here we find and elsewhere we shall find ourselves talking of functions under the head of structures. This can scarcely be avoided if we are to draw sound conclusions. Indeed we may add that the functions of any living matter must always be connected with the structure it manifests both as consequence and as cause. In fact, we have adopted the division for convenience sake, more than from a belief in the real importance of the distinction. Before concluding our remarks, we shall hope to summarise the results of both inquiries.

Of the new formations, the Enchondromata seem most pointedly to illustrate reversion. Enchondroma myxomatodes presents characters such as are seen in the notochord, or chorda dorsalis, of the Vertebrata. The cells of some Enchondromata are stellate, their processes uniting into a network. In order to see a like condition, we must descend to near the root-forms of the vertebrate-tree, the Selachii. Again, Enchondromata are most common in the limbs and especially in their distal parts; and, since the original condition of the vertebrate limb is represented in the Selachii as a multitude of cartilaginous rods arranged in a definite manner (the rods increasing in number towards the distal extremity of the pro-pterygium, the meso-pterygium, and the meta-pterygium), we are inclined to regard these several facts as showing homologous relationship.

Corroboration is seen in the frequency with which cartilaginous bodies develop in connection with certain joints of the limbs in man and animals. These bodies are either single or multiple, and they are of all sizes up to that of a small apple. Cruveilhier figures a number of rounded cartilaginous bodies in the elbow-joint. Mr. T. Smith removed *over 200 loose rounded cartilages* from the knee-joint of a man on December 13th, 1882, at St. Bartholomew's Hospital. He also operated on a woman whose case

has been recorded in the 'Transactions of the Pathological Society of London,' vol. xxxi, by Mr. Harrison Cripps, Assistant Surgeon, St. Bartholomew's Hospital. This woman, aged twenty-eight years, had for six years presented a tumour in the upper third of the right arm, immediately beneath the skin. The tumour was pyriform, tapering towards the axilla. It was three inches and a half long, and two inches in diameter at its thickest part. It was encapsuled, and within the capsule there were found one large mass of cartilage, and *twelve or more detached lobulated bits* of cartilage. There were also similar detached nodules of cartilage in the axilla.

In fact, the limbs of the higher animals have dormant germs of the ancestral rods of cartilage. Indeed, cartilage cells have been found in the synovial tufts of some joints. From such centres some of the above-mentioned cartilages had apparently developed.

Supernumerary fingers have been referred to the multifid condition of the rays of the Selachian fin.

Again, new formations of capillary vessels are generally congenital, and they are much commoner in the skin of the head and neck than elsewhere. These facts might suggest the possibility that they bear homologous relations to the vessels which develop about the epiblastic involutions lining the visceral arches of the lower Vertebrata. Dr. D. A. Gresswell recently saw a nævus, the distribution of which seemed to afford some corroboration for such a speculation concerning the homology of nævi. It extended in a snake-like form down the right side of the neck; it was distinctly raised, and it passed with a tapering extremity into the external auditory meatus, down which it extended for some considerable distance.

The lowest forms of life multiply by fission and gemmation; those which are a little higher in the scale, by gemmation. While, however, gemmation in the higher animals for the purposes of reproduction is limited to certain parts of the organism, in the lower it seems that gemmation may occur at almost any part. Even many Arthropods will throw off a leg at the joint above a lacerated segment, and then bud out a new limb from the centre of the stump. Similarly the newt will, it is said, replace an eye. May we bring into relation herewith the granulations which tend to occur on cut surfaces, the papillomata and other growths which occur on irritated parts of skin and mucous membrane, the villi of the chorion and their abnormal developments?

The Embryonic Layers.—The primordial condition of

living forms is said to be protoplasm, apparently alike in its several parts, both in structure and in functional capacity. A later stage in animal history is that represented by the Diploblastica, in which two layers of protoplasmic units are differentiated, either of which is capable of taking on the function of the other. A third stage is represented by the Triploblastica, in which no such distinct reversal of function is possible, and in which each layer is largely independent in its structure and functions.

The independence of the epiblast and the general likeness of its parts in higher animals are manifested in many ways—normal and reversional. There is correlation of thickness and colour of the skin and hair. Some mammals develop hairs within the mouth, and most members of this class of animals develop hairs within the nose and external auditory meatus. Some develop hairs on the conjunctiva. The *Selachii* present every step of transition from scales on the skin to teeth in the mouth, and these structures are limited to regions covered by epiblast. There are also reversionary manifestations. The development of hair all over the body, the palms and soles excepted, has been noted in both man and woman. It is an interesting fact that the size of the teeth in higher animals is much more constant than that of the jaw bones. Is it that teeth have a much longer ancestral history than jaw bones? As bearing out this idea, it may be pointed out that the *Selachii* have marvelous teeth, while their jaws consist only of cartilage with a calcareous coating. Or is it that enamel is developed from the epiblast, while jaws are of mesoblastic origin, and that the independence of these layers serves to explain the contrast? It is not apparently wholly attributable to varying degrees of use and disuse.*

The rashes of the specific fevers are of interest in this connection; for, though some of them are primarily mesoblastic changes, and though we cannot assert that similar changes do not occur elsewhere in the body, they do illustrate in some of their manifestations the similarity of the parts which they affect. Take, for instance, the rash of scarlet fever. It may occur in any part of the skin. It occurs on the face, though we may not be able to distinguish it there so distinctly, owing to the fact that the skin of the face is naturally more full of blood, and also to the fact that the scarlatinal rash is much more uniform than most rashes are. The desquamation of fevers may be partly due to the rise

* The effects of use and disuse are obviously, however, often greatly obscured, and difficult to trace out thoroughly.

of cutaneous temperature, but not wholly ; and the fact that desquamation occurs on the face as elsewhere corroborates the view that the skin of the face is altered in some degree, as is that of the rest of the body. The rash occurs on the scalp and on the oral and faucial mucous membranes. It occurs probably on the nasal mucous membrane, as evidenced by the constant thick stream of discharge so frequently seen flowing from both nostrils in infants and children. It occurs on the conjunctiva. It occurs not only in the external auditory meatus, but also, we are inclined to think, in the middle ear and Eustachian tube. These affections of the mucous membrane of the middle ear and of the Eustachian tube in cases of fever are, however, generally said to be due to an extension of inflammation from the fauces. It may be readily allowed that a *simple* inflammation may extend from the throat into the tympanum. In the case, however, of a *specific* inflammation, affecting as it does the general surface, we may be tempted to reflect upon the fact that the mucous membranes of the fauces, Eustachian tube, middle ear, and external ear are differentiations of a once common structure which lined one common cleft—the Tympano-Eustachian cleft, the permanently open *Spiracle* of the Selachii—and to consider that inflammation in these several parts in the specific fevers may not be the result of extension, but a primary event, they, like the structures from which they are differentiated, reacting somewhat similarly to the same force.

The same may be said of measles and of small-pox.

In Eczema Epizootica, vesicles, similar to those in the mouth and between the hoofs, develop even within the lacteal ducts.

As serving still more markedly to illustrate the independence of the epiblastic structures, there is the fact that epidermal cells are necessary to the new growth of epidermis, and also the point implied above, that the enamel organs of the higher animals are of remarkably constant size as compared with that of the jaws. Further, though we do not yet know whether belladonna and jaborandi act upon the secreting cells in the abdomen, we do know that the former causes dryness of all parts of the skin, including the mammary involution, and also of all parts of the mouth and throat ; and, further, that the reverse holds with jaborandi. Similarly, a patient suffering from rheumatic fever presents a moist tongue and an excessively moist skin. A phthisical patient also generally presents a moist tongue and a moist skin.

It has been suggested that the comparative frequency of

hair-bearing cysts in the brain is to be referred to the fact that a large part of the cerebro-spinal system is of epiblastic origin. Their presence in the ovaries is similarly regarded by some.

It is likely enough that homology for many skin eruptions such as psoriasis, ichthyosis, and eczema is to be looked for low down in the scale of vertebrate life.

Reversionary processes serve also to explain other irregularities of structure. To E. Haeckel's law, the "*lex hereditatis interruptæ*," are referred cases of atavism of which alternation of generations is regarded as a physiological, and gout as a pathological, example. The application of the law may be extended to include cases of reversion to a long-lost ancestral trait. Among these we would include the above-mentioned cases of Enchondromata. The cases of suprascapular developments recently brought before the Royal Medical and Chirurgical Society of London by Mr. Willett, Surgeon to St. Bartholomew's Hospital, and Mr. W. T. Walsham, Assistant-Surgeon to St. Bartholomew's Hospital, were similarly regarded. Mr. Charles Gresswell, M.R.C.V.S. (Nottingham) informs me that he recently saw a foal which presented a tridactyle foot. The lateral splint bones were almost as largely developed as the cannon-bone, and each was provided with pastern bones and a hoof. How clearly this points to the ancestral condition presented by the Eocene Eohippus, the Miocene Anchitherium, the Pleiocene Hipparion!

Another of Haeckel's formulæ, the *lex hereditatis abbreviatæ*, is of interest. It is illustrated in the fact that Podophthalmatous Crustacea in the course of their development omit the Nauplius-form, and pass very quickly through the Zoea-form. It may lie at the root of the difficulties which beset the determination of the homologous relations of Müller's duct with the segmental organs of lower forms.

The *lex hereditatis sexualis* is also important. Male Arthropods have often been placed in a genus or even order other than that in which the female has been placed. There is probability that to this law should be referred the fact that horses and geldings are more liable to roaring than mares (mares seldom being roarers, save when there has been close in-and-in breeding), the fact that ichthyosis descends in only the male line, and possibly yet other facts of distribution of morbid processes between the sexes.

The *lex hereditatis adaptæ* speaks of progressive heredity. To it is referred the case of a bull, which, after receiving an injury to the tail, became sire to offspring in none of which a tail developed. The epileptic guinea pigs of Brown-

Séguard, afford another illustration. Mr. J. Brodie Gresswell, M.R.C.V.S., Louth, recently showed me the leg of a foal in which the only development of bone below one hock was a small nodule in the position of the proximal part of the metatarsal. The dam had suffered for some years from stiffness of all the joints below the hock of the corresponding leg. There have been also cases of a similar nature in man.

The former laws illustrate the importance of reversionary processes, while the last illustrates the more direct importance of incident forces.

Age.—Regeneration in mammals is the more active, the younger the individual. Similarly, regeneration is the more active, the lower in the scale of life the animal may chance to be. In the ova of higher animals changes may indeed occur which recall the methods of reproduction in lower forms. The early embryo may apparently divide, and each half develop into a perfect adult, a case of fission such as may be seen in the lowest of living things. The embryo even of man may, some think, attempt to reproduce a limb, a process which is common enough in lower forms, even in their more adult condition.

The babe crawls, before it stands erect; and the relation of its head and legs to the trunk for some time after birth is just that which is presented by a lower animal.

It appears that the epiblastic involutions about the head and face acquire during extra-uterine life a certain degree of independence of the rest of the epiblast. This is exemplified in the fact that coryza and otorrhœa are much commoner in infants and children than in adults in cases of suffering from scarlet fever. It is the same with measles. Moreover, even the parts of the skin apparently become differentiated with age, as is seen in the greater frequency with which a general hyperæmia occurs in cases of smallpox in children than in adults. It is not rare to see children suffering from smallpox certified to be suffering from "scarlet fever with possibly varicella."

Erect Posture.—Among vertebrates the erect posture is met only in the more highly differentiated. The erect animals are supposed to have been evolved from animals which were prone. Comparison between the former and the latter may then afford aid in the interpretation of some vital phenomena. A few scattered points in reference to this question are subjoined.

The lower surface of the prone animal corresponds to the front surface of the erect. The ventral or abdominal surface, which in a prone animal is in relation with the earth, has

come to be in the erect animal in relation with space. Herein there is involved a great alteration in the supply and loss of heat. To the prone the earth affords a protection from excessive radiation. This is illustrated by the fact that rabbits, when placed supine, die of refrigeration. The abdominal flannel worn in climates where there are sudden and great changes of temperature may be mentioned in this connection.

The abdominal contents in the erect animal tend, should their supporting tissues yield, to press upon the pelvic and inguinal structures, while in prone animals the pressure is downwards and forwards, in accordance with the slope of the ventral wall of the abdomen. Hence the fact that femoral, scrotal, and obturator herniæ are rare in animals as compared with man, while diaphragmatic and umbilical herniæ are as common, if not commoner. The reply that most horses are castrated is met by the further fact that scrotal hernia is rare in army horses and in thoroughbreds, animals which are not castrated.

A child must at an early age begin to place all its weight upon the hind extremities. This fact explains in some degree the frequency of knock-knee and bowed leg in man as compared with animals.

The rudimentary condition of the coccygeal vertebræ (vertebræ which lie behind the sacral, *i. e.* behind those which serve for support of the pelvic girdle) in erect animals has apparently special reference to their erect posture. Should a quadruped become erect, the tail would apparently but embarrass the action of the legs. Many arboreal animals are erect, and yet have tails; but to them a tail is of use as a prehensile organ, and also as a protection to the pelvic outlet. Again, though some ancient and transitional forms of birds had tails, we know of no long-tailed modern forms. The anthropoid apes, moreover, have the tail but poorly developed. There would also be a further advantage in losing the tail, *viz.* that to be derived from a more consolidated condition of the sacrum, attending upon atrophy of the coccyx. This correlation is actually manifested in animals, and it furnishes a reason why the operation of docking is not performed on race-horses. This operation, indeed, has other effects than a mere æsthetic one—effects which possibly tell upon the condition of the hind quarters. The practice of docking is, however, rather severely animadverted upon by Dr. George Fleming, an eminent authority on veterinary subjects, *vide* 'The Book of the Horse' (Cassell & Co.), by Sydney and Fleming.

The shape of the tail, however, changes, as prone animals

become erect, a change which serves in some degree to support the pelvic structures. Despite this fact, however, falling of the womb and other displacements of it are comparatively frequent in mankind. They may be owing in part to the possibility that the walls of the vagina and the perineal body were not framed to support the weight of the uterus, the bladder, and other structures at the pelvic outlet.

When grey horses pass into years, melanotic tumours often develop, and very frequently on the under surface of the tail, as well as elsewhere. This fact of distribution of morbid processes, it may be well to bear in mind, when comparing tailed quadrupeds with so-called tail-less bipeds. Dr. A. Gresswell, B.M.Oxon., recently examined with me some of these tumours. The microscope revealed a closely-packed mass of deeply-staining nuclear bodies, each surrounded by a small amount of pigmented matter. The nuclear bodies infiltrated every tissue, even the intima of the arteries.

The hind limbs of quadrupeds have a circulation which is feebler than that in the fore limbs. The erect posture of man may further impede the circulation in the lower limbs. Hence the rarity of "lymphangitis" of the fore limb of the horse, and also the frequency with which gouty deposition in man first occurs where the circulation is most sluggish. Though these two affections are here brought together, it is probable that they are not so closely related as are laminitis of the horse and gout of man. Indication of the close relation which these latter bear to each other is seen in the fact that the horse which has access to wheat is almost certain to become affected with laminitis, wheat, as compared with the natural food of the horse, being more highly azotised.

There is also interest in the fact, that the nasal or oro-nasal portion of the respiratory tract forms with the tracheal portion of this tract a smaller angle in man, than it does in animals. Since the bending of a tube the more greatly diminishes the velocity of currents passing through it, the more it is bent, it comes about that man, when in need of more air (as in ordinary dyspnœa, in fever, and other conditions), has occasion to throw back the head through a larger arc than has a lower animal. A man who is dyspnœic places the head in that relation with the spine which was natural to a remote ancestry, and so it is, but to a less extent, with some of the higher animals. This posture taken by man in dyspnœa is precisely that in which a new-born babe sleeps. It is possible that, if the fœtus maintains the same relative position of head and trunk as is seen in the newly-

born babe, and if we couple herewith the anatomical relations of the bladder (but rarely empty), and the flaccidity of the other pelvic contents, we may in these facts see a reason for the very general "head presentation" in man, the head presenting because the pelvis and its contents accommodate the fœtus in this position better than in any other. The same, too, holds of many lower animals, both prone and erect.

Again, the erect posture affords a freer play to the movements of the fore extremities. Dr. G. Rolleston taught that such additional freedom had done away with the necessity for the continued development of the panniculus carnosus, and so had become instrumental in effecting its atrophy. This muscle is engaged in ridding the skin of some parasites, also in defensive and offensive operations (as in the erection of the spines of the Diodon, the scales of serpents and of the Manis, the quills of the porcupine, and the bristles of the hedgehog). Man, however, in virtue of his erect posture, has so much more freedom of movement of the fore extremities than have prone animals, that this muscle from disuse has atrophied. The fact that man has remnants of this muscle in the platysma myoides, and, according to Henle, in several muscles of the head, should be considered in relation with the fact that hairs still flourish on the head, the face, and upper part of the neck, and that these parts are not clothed. Birds, however, are erect, and yet some have a remarkably well-developed panniculus carnosus. This muscle presented even large tendons inserted into the feathers and skin of an albatross which Dr. D. A. Gresswell recently dissected. In birds, however, the fore limbs are more particularly specialised for flight, while the freedom of movement of the fore limbs in other directions is correspondingly curtailed. Man, inheriting the traits of a once quadrupedal condition, presents, like quadrupeds, right-handedness, but in greater perfection than they; for the fore limbs, being freer to act, have acquired a still greater independence of each other. The fact that the right limbs have taken on the more complex tasks is attributed to the left side of the brain receiving a more direct supply of blood; and this view is corroborated by the frequency with which embolism occurs on the left side of the brain as compared with its less general presence on the right. Similarly, the greater frequency with which embolism occurs in the left as compared with the right kidney is attributed to the more direct course of blood to the former.

Before closing our remarks on abnormal structural manifestations of evolution, we may say that the separate hints

we have given arranged under the heads—Phases of Nutrition, New Formations, The Embryonic Layers, Age, and The Erect Posture—all point to the idea that connections are to be traced among the phenomena of disorders and diseases of animals which point unmistakeably to gradual development. Much remains to be done on the same and similar lines. How important it is that such connections and such causation should be traced will be readily seen by all those who are concerned in the curing and prevention of the various maladies of man and beast.

II.—SOME ABNORMAL FUNCTIONAL MANIFESTATIONS OF EVOLUTION.

The statement that the functions of an organism, or a group of organisms, or indeed of the whole aggregate of organisms, no less than the structures which make up an organism, or the whole aggregate of organisms, are intimately connected one with another, will require but little enforcement or illustration in this place. Indeed the mutual interdependence of functions is universally admitted. The assertion that the various processes of change going on in a higher animal, that is its functions, have been evolved in association, has been amply supported both inductively and deductively. The phrase, "associated functions," like the corresponding idea of "correlated structures," expresses a great truth.

The canary, when building in captivity, may be seen to fly about its cage with the straw, before placing it in the required position, that is to say, it unnecessarily attempts to do under altered circumstances what canaries are obliged to do when making their nests under the ordinary conditions of nature. Similarly, fowls are more likely to transgress a netted boundary, if it be topped by a rail, apparently because they are in this way reminded of ordinary obstacles; whereas a net itself is not a conspicuous hindrance to free movement. A somewhat dissimilar, though still more striking, illustration, of the intimate connection which subsists between intricate nerve impulses, is seen in the observation that a man, who, on joining the navy, is awakened by the morning report of the cannon, at length becomes so far accustomed to the sound that the fact of its non-production may awake him, while the sound itself may not do so. Thus we note that, by continuance in new conditions, men and animals gradually acquire new habits, although in many cases relics of the old ones remain. The functions which will persist for

the longest time are those which have, by any means whatever, been most strongly impressed upon the organism, or upon its progenitors.

While animals roam at large, their characters may remain similar, or almost identical, for long periods of time. By careful selection we may greatly change a feather, a limb, or, indeed, in time, the whole animal. If again allowed its freedom, the creature will soon revert to its original state.

Similarly, a swinging pendulum presents a definite movement, which may be easily altered by the application of a slight disturbance. Nevertheless, the original movement will gradually reappear.

The same is seen in processes which are called abnormal. Man and animals may acquire a certain degree of toleration for morphine, for alcohol, for arsenic, for tobacco, for infective agents. Toleration, however, wears off, when the modifying agent ceases to act.

We shall now endeavour to bring forward an idea of two sets of "associated functions" which have not, we think, as yet received special notice, and to trace the two sets, if possible, from their physiological expression into the region of pathology.

The phenomena presented by animals may be divided into two sets, not entirely distinct, it is true, but connected as are heat and cold. The functions which make up each group have been associated together for untold ages. The two states corresponding to the two groups of organic processes are respectively designated *work* and *rest*. It will be convenient to speak of the one group of functions as "the associates of work," and of the other as "the associates of rest." We hope to prove that, when some of the associates of work are manifested, others of the group will also tend to appear, and similarly in the case of the associates of rest.

Turning to another but an allied point of view, we remark that the phenomena which constitute *day*, like those which make up *night*, have likewise been in each case co-existent for indefinite periods of time. Moreover, the associates of work have alternated with the associates of rest to a large extent in the same way as day has alternated with night, and on a larger scale to some extent as summer has alternated with winter. We shall not be surprised then to find that the rhythm of surrounding conditions has left its impress on the organic rhythm.

Work.—An animal at work presents many associated phenomena, of which we will mention acceleration of the pulse and respirations, excitement, increase of perspiration

and of fecal discharge, and augmentation of metabolism and body temperature.

There is evidence to show that, if some of these be aroused, there is a tendency for others, or all, to be aroused. If the temperature of an animal be artificially raised, the pulse and the respirations are accelerated, and the cutaneous glands are more active. The converse is the case, if the temperature be reduced.

Increased defecation we have mentioned as a work-associate. Cattle, when suddenly disturbed, defecate, and set off apace. The horse passes feces, which become increasingly fluid while the animal is engaged in the chase. A cockatoo and a blue-mountain, lately taken from the bush in Australia, were observed to defecate, whenever a stranger approached their respective cages, and they continued to do so for some time after the commencement of their captivity. Again, in man, relief from constipation is very generally afforded by physical work or by excitement.

These and other facts point to an association between work, excitement, and increased defecation, resulting in reduction of weight. The cockatoo not only defecated when strangers approached, but also simultaneously raised its head-plume—a preparation for defence.

Action is also coupled with increased temperature. A contracting muscle rises in temperature, and there seems to be a very considerable total increase of heat in the body during action.

With action, with excitement, with alarm (if not too great), there is also associated an accelerated pulse. The pulse of an excitable thoroughbred, or even of a cart-horse, is much higher, if the animal is roughly approached than it otherwise is, and the same holds with other animals, and with man.

The association, moreover, of some of these phenomena serves apparently to explain some pathological phenomena.

In cases of exophthalmic goitre the heart beats more frequently, the action of the cutaneous glands is increased, there is restlessness, the bowels are generally freely open, though the patient be confined to bed, the peripheral temperature is elevated, and at times also the oral temperature. These are the associated factors of work.

Dr. D. A. Gresswell took daily observations for thirty-three days upon a woman, aged thirty-two years, suffering from this condition, under the care of Dr. Southey, at St. Bartholomew's Hospital. Her pulse was always above 110, even when she was asleep. Her respirations were always above 22. The bowels were very freely open every day on

an average 2.4 times. The daily urine averaged fifty-two ounces, varying, however, from forty to eighty ounces. She slept fairly, when sedatives were administered; but otherwise she was restless. The skin was at all times warm and moist. The tongue also was always moist. The appetite was always excellent. The oral temperature was generally normal; but it rose at times to about 100° F., and the palmar temperature was generally nearly as high as the oral.

The records of other uncomplicated cases agree, in the main, with this.

Some other diseases also, in which the heart's action is accelerated, illustrate the same thing. Looseness of the bowels is often seen in children at the outset of scarlet fever, smallpox, and measles, and in those instances where Dr. D. A. Gresswell has seen typhus fever from the very outset, the bowels have been loose for a day or two. No doubt in such cases other causes also are in operation.

In the *British Medical Journal* of July 26th, 1884, the same observer has recorded facts to show that the total heat in the body is greatly increased on entering the tropics, and that the increase is greater in children than in adults. He has also adduced facts to show that an increase in the intensity of light causes acceleration of the pulse. This acceleration was most marked in the young. Now, diarrhœa also increases on entering the tropics, and especially in children. Summer diarrhœa may doubtless be due to various causes. Of these, he is inclined to think that the direct action of an increase of external heat and light upon the body may be of the greatest importance. Most of the children (about 50) among 400 emigrants recently taken to Adelaide in the "Aldergrove," suffered from diarrhœa on entering the tropics. They were fed, however, in the tropics, much as they were in the temperate regions. The milk supplied to the younger ones was made up from condensed milk twice daily, and *every precaution was taken against uncleanness*. Adults also very frequently have looseness of the bowels on entering the tropics. This he has observed, moreover, among the adult occupants of different parts of the ship during several passages through the tropics. The two chief climatic factors are rise of external temperature and increase of intensity of light. The organic factors are rise of body temperature, acceleration of pulse and respirations, increased action of skin, diarrhœa, in short, work-associates.

The facts that a child's temperature will rise in *constipa-*

tion, and fall when the bowels are relieved, do not militate against the view above drawn concerning the association of rise of body temperature and defecation. It is paralleled by the fact that the temperature of a typhoid patient may rise during the convalescent stage, owing to constipation, and fall after an action of the bowels, induced, it may be, by castor oil. Indeed, though paradoxical, these cases do but corroborate what has been said. The fecal accumulation excites the intestinal mucous membrane and the intestinal muscle, with additional activity of which, according to the view expressed above, rise of temperature and other work-associates are naturally coupled.

The ready response of a child's temperature to irritation and excitement is well known. This greater readiness in children as compared with adults is put down to a condition of less stable equilibrium. Patients also, especially those convalescent from febrile conditions, show a like contrast when compared with healthy persons.

It seems, in fact, that the processes of work have been evolved in such intimate association that, when one of them is excited, the others also are. Hence diarrhœa concurs with the rise of temperature and the acceleration of the pulse in the tropics. Acceleration of the pulse in the tropics has been denied. Dr. D. A. Gresswell's observations upon a large number of persons under different conditions while passing from temperate through tropical latitudes on four different occasions show that there is an acceleration of the pulse in the tropics under all ordinary circumstances.*

It may be said that the evacuation of the bowels during work is due to an increased action of the diaphragm, abdominal muscles, and levator ani. It certainly cannot, however, be strongly maintained that this has much to do with the purgation accruing from excitement during rest.

Moreover, the action of some chemical compounds serves to illustrate the association of vital processes mentioned above. For instance, the administration of nicotine results in acceleration of the heart's action, perspiration, and diarrhœa—work-associates; while morphine in a certain dose, on the other hand, causes a slowing of the pulse, a dry skin, and constipation.

Rest.—It may readily be seen that the associates of rest

* The pulse may be slower in a tropical latitude when compared with that in a colder latitude, if the body be recumbent and at rest; but this is possibly, or indeed probably, attributable to a weak condition of the heart brought about by previous excessive action.

are the counterparts of those of work. Rest presents degrees. An animal may be more or less completely at repose, or it may present the still more pronounced rest of sleep or hibernation. If a man or an animal does not take physical exercise, constipation very frequently results. If one or more of the work-associates are kept in action, sleep is almost impossible. When too hot, or greatly excited from any cause, we cannot sleep.

As we have pointed out above, there is apparently an association of certain vital processes which are concerned in action. If one is strongly aroused, or, *à fortiori*, if more than one are evoked, the others are generally also induced. There is also another association of vital processes called rest. If some of these are exhibited, then, in the general way, the others will also be more or less strikingly apparent.

In this connection it may be of interest to compare the cart-horse with the thoroughbred. The former puts out force more slowly, and is less sensitive to pain. Its vital processes are slower, and it is therefore less liable to acute inflammations. Should it become subjected to them, it does not make so rapid a recovery. The thoroughbred will, as it is said, nearly jump out of its skin, owing to a degree of irritation which a cart-horse will scarcely be aware of, is more sensitive to pain, and withstands the effects of a much larger dose of chloroform. The thoroughbred is more likely to develop hypertrophy of the heart; the cart-horse a fatty liver and anæmic dropsy. In the thoroughbred there is in fact a more pronounced development of the work-associates. Men also of different temperament and constitution present like contrasts.

Work and Rest.—Muscles, if freely exercised, hypertrophy; but, if due rest be not allowed, they atrophy. The same applies to other tissues and organs. This fact, well known in man, is true also of animals, and is observable in the case of the heart of the race-horse. All racers acquire hypertrophy of the heart. The hypertrophied tissue, however, by excessive action degenerates. Mr. Charles Gresswell, M.R.C.V.S., informs me that the race-horse at five or six years of age loses form to such an extent that, in handicapping for racing, weight is taken off rather than added to, after the age of six years, and that, when racers go to stud (as most of the best racers do at about the age of six years), the heart, no longer called upon to undergo the exertions of former times, fast degenerates. One such heart recently examined after death by us was three times its normal size, fatty, and dilated. Mr. Herbert Spencer shows that, by alternate

squeezing and relaxation, currents pass to and fro in plants, in trees, in animals, and he thus explains many normal growths, as also the formation of bone that fills up the arc of the curve in rickets. The same explanation has been applied to the development of ringbones and bone spavins in the horse, and it may be applied also, we think, to some cases of splints and to sidebones.

Rest and work must alternate. We see the injurious effects of disturbance of this alternation in tissues and organs. We see them, moreover, in the system, as a whole. Lymphangitis, or 'weed,' of the horse, for instance, is so common on Mondays that it has been called 'Monday morning disease,' a fact which indicates its relation to Sunday's usually complete rest and over-feeding. Man, too, pays a like penalty for like indulgence.

The alternation of work and rest in animals has been observed for ages past, and it is important to attend to preservation of this rhythm, for the muscle, the limb, the organism, the species, suffers, when the old alternation is too abruptly, or too largely, interfered with.

It is said that some plants grow more quickly, and apparently more perfectly, when subjected to the action of a light of constant intensity, than when left to sunlight; but, in comparing the higher plants with the higher animals, it is well to remember that plants are (as Herbert Spencer has said) *accumulators*, while animals are rather *expenders*.

Elasticity, we may suppose, would develop *pari passu* with contractility. It is an essential property of muscle. It is also apparently indispensable in the case of those structures which are displaced by muscular action from their position of rest. For instance, in expiration, not only do the inspiratory muscles recoil by virtue of their elasticity, but the ribs, costal cartilages, the lung itself, and the laryngeal and facial respiratory mechanism, one and all recoil by virtue of their elasticity. The claw of the carnivore, disturbed by muscular action, recoils by virtue of elasticity. Many organs, after suffering engorgement as a result of some degree of paralysis of pale muscle, recoil to their original size, largely by virtue of their elasticity (Hilton). This is illustrated in erectile organs, spleen, liver, and other organs. The elasticity of skin, again, is a most important property. The arm of a man enlarges with each systole of the heart, and it diminishes with each diastole, so that the elasticity of the arteries, in assisting the circulation of the blood, has a *collaborateur* in the skin.

Indeed, in the history of the individual, as in that of the

race, elasticity runs *pari passu* with irritability. The recent investigations on *Eristalis* are of singular interest in reference to the relation of muscular and elastic tissues. In the later years of an animal's life elasticity diminishes, and the left ventricle hypertrophies, owing to loss of elasticity, not only in the arteries, but also in the skin and other tissues.

Day and Night.—Day is characterised by sun-light and sun-heat; and with day there have been manifested in animals, for untold ages, the associates of work. The pulse and respirations are more frequent by day. Metabolism, as evidenced by the separation of carbonic acid and urea, is greater. The body temperature is higher. In the *British Medical Journal* of July 26th, 1884, Dr. D. A. Gresswell recorded evidence to show that light stimulates the heart, and that tropical heat is accompanied by rise of body-heat. Moreover, physical work is one expression of increased metabolism, and the absorption of food is accompanied by rise of temperature.

The factors, then, which constitute day, external or inorganic and internal or organic, are each and all concerned in adding to the activity of vital processes. The external factors (light and heat), in reference to the internal, stand to some extent directly in the relation of cause and effect. They stand also indirectly in this relation, as they afford opportunities for working which are not present by night.

A rhythm has thus been established in organisms in relation to day and night. It is, moreover, kept up for a time, even when some of the factors concerned in the causation of the rhythm are altered, just as the variations in the frequency of the pulse which have reference to meal-times persist, even if we pass the whole day without food. For instance, when we commence to work by night and rest by day, it is some time before we obtain a reversal of the temperature curve, and the reversal is probably never complete. If, however, we proceed *gradually* from one meridian to the antipodal meridian, we *gradually* change all the associated factors of what was our day for those of night, and under these circumstances the daily curve of body temperature persists; but there are facts which tend to show that, even under these circumstances, the old rhythm does not yield with the best grace.

Moreover, in pyrexia the body temperature tends to rise and to fall, at the same times as it does in health. The fact that pain is so generally more intense by night than by day, and the greater likelihood of a febrile patient being restless

and afterwards delirious by night than by day, though the temperature be no higher, may be paralleled by the fact that in health, when hot by night, we cannot sleep, while we may, though hotter, be able to sleep by day. Day is the time for action, and the febrile temperature is therefore better borne then, than it is by night.

Months.—The monthly divisions of time have reference to the phases of the moon. Menstruation was referred by Darwin to an ancestral time when spring tides brought an extra supply of food. The fact that delivery occurs at the usual time of a menstrual epoch is read in the same light, and similarly with *ante-partum* hæmorrhages.

The Seasons.—Summer and winter differ much as do day and night, and they likewise merge into each other imperceptibly in different ways. In summer there is an addition of light, of heat, and of food. There is also an addition to the activity of life's processes. In spring and summer, as compared with winter, the pulse is quicker, the temperature is higher, metabolism is more active. With each recurrence of spring, life, comparatively dormant during the winter, bursts into renewed activity. The hibernating animal takes new life. Spawning, and pairing, and reproduction of all kinds of animals, now take place. There is also a great increase of peripheral growth, as shown in quicker growth of hair, nail, and hoof, and in the shedding of hair and cuticle in moulting.

We concluded above that vital activity had been so long associated with day as to explain the fact that organisms exhibit a rhythm corresponding to the alternation of day and night. There is some evidence that organisms exhibit another rhythm corresponding with summer and winter. The Rev. J. G. Wood records a case in point. Some Australian plants, set in the suburbs of London, made an attempt to blossom just as our winter had set in; but in the course of a few years they grew gradually later in blossoming, until they had found the proper season, and then they were content to put forth their leaves and flowers at the same time as the indigenous plants. Hilton, in his 'Rest and Pain,' mentions facts which he interpreted in the same way. Moreover, Dr. J. Crichton Browne says that many children at spring show a restlessness and excitability, a perversity and irascibility of temper, or a listlessness and indisposition for exertion, that are not seen at other times, and he suggests that these so-called irregularities are to be classed with the vernal activity of organisms generally.

The Fight. Excitement.—Animals quickly enter into

competition with one another, when introduced into a maiden environment. The majority of animals may be called upon at any time to fight, or to make good their escape. In either case the associates of work are summoned into action, and in the fight there may be pain, with anger and rage, and therewith redoubled energy.

Pain.—The question of pain and its relation to disease on the one hand, and to the injuries received in fighting on the other, is one of great importance. Pain is made up of disagreeable and irritating sensations, in response to which an animal may exert its best endeavours to remove itself with all speed from a source of injury or danger. Again, its movements may be determined with the view of satisfying the pangs of hunger or thirst, or indeed of supplying some other want or wants which entail suffering. Among animals, pain is very generally associated with the excitement and furious rage aroused in fighting with competitors or combatants, in fact in struggles for self-preservation. As applicable to the vegetable kingdom, we cannot use the same word "pain." The reactions of plants are not of such a character as to admit of the idea of suffering. The lower plants, being motile, and, if we may use the expression, more animal in character than the higher, react to stimuli in ways resembling those of animals of corresponding size and differentiation. In the closing of petals by night and in their opening by day, and likewise in the phenomena of the "sensitive plant," we have among higher vegetals reactions not unlike those presented by animals. Still, there is nothing in plants to which an idea of pain can be ascribed.

In an animal suffering from pain there are exhibited the "associates of work." The heart's action is increased, as also is that of those muscles, which in fighting would be directly or remotely concerned. Even the muscles of the ears, eyes, and lips may be, more or less strongly, brought into action. In pain there are likewise more or less intense excitement, perspiration, and perhaps screaming. These associated functions then concur in animals, including man, not only when they are consciously and suitably directed to the removal of a pain-giving agent, but also when the pain cannot be thus removed, being due, as in disease, to causes of quite a different character. In the former case the reactions are self-preservative in nature, leading as they do to redoubled efforts at defence, while in the latter case they may be not only not beneficial, but of a very harmful, and even fatal character. In an acute attack of gout the febrile disturbance is supposed to be secondary to the joint-affection.

The manifestations are acute pain, rapid pulse, some rise of temperature, perspiration, great restlessness with excitement, "expression of the emotions," possibly screaming.

It is a most noteworthy fact that the pulse of an animal suffering from pain is almost invariably accelerated. In the case of a horse suffering from pleurisy the pulse may fall as much as thirty beats per minute, when the pain is relieved by the application of a tight bandage to the chest. The same diminution may be noted when a horse suffering from laminitis lies down, as a result of exhaustion. Not only is there an acceleration of the pulse-rate in animals suffering pain, but the beat itself is strong in character. This, too, is very noticeable in horses afflicted with this same disease, laminitis.

Restlessness and vigorous action of the muscles are likewise manifested by animals which are in pain. When a corrosive is applied to a quittor, a horse will stamp with energy. Similarly, the leg of a frog contracts, when it is irritated by an acid, or in other ways. Indeed, that movement follows pain, certainly in the case of all higher animals, is so well established, as to need but little illustration. We are so accustomed, in short, to the invariable connection which exists between these two vital manifestations, pain and movement, that we infer the absence or presence of pain, according as we do, or do not, observe its correlative signs. Indeed, it is possible we may be sometimes mistaken. On the one hand, a cry of anguish may not in all cases denote pain. On the other hand, the absence of signs of pain—for instance, in calm resignation—may not be inconsistent with great suffering. We find that groaning, screaming, perhaps sobbing and weeping, grinding of the teeth, clenching of the hands, violent paroxysms of convulsive movements, are seen in most of the higher animals when suffering pain. Frequently these and the like phenomena can only be ascribed to their association in the past with pain as resulting from direct struggles with a foe. In the fight all the muscles and organs of the body receive an intense impetus. Scarcely can there be cited any normal function which might not be of use in certain contingencies. The brain must be quick to see in advance the tactics likely to be used by the opponent. The heart must be ready with supplies to any and every portion of the body. The eyes and ears must be more sharp than usual. Hence the muscles connected with these sense-organs are, so to speak, on the alert, and ready to set them to the best advantage for hearing and seeing, and also in some instances to protect them from

injury. In short, nearly all the muscles of the body are liable to be called into action. The wild and piercing cries uttered by a creature almost worsted in the deadly strife, re-echoing far and wide, may avert a threatened defeat by frightening the antagonist, or by attracting comrades to help. The quickened action of the heart raises the external temperature, raises the body temperature as a whole, since it leads to quicker oxidation. Thus we see that in the struggle there are exhibited phenomena similar to those of pain. In pain the temperature frequently rises measurably, and it falls when, by means of morphine or otherwise, the suffering is subdued.

Inflammatory fever may be attributed to the same processes which operate in the rise of temperature which is observable in pain. This we have attempted to trace to the struggle for existence, and inflammatory fever is possibly its pathological expression.

In this relation it is well to bear in mind that peripheral increase of heat may occur, though the oral temperature be not altered. Increased supply of blood leads to augmented action of muscles and organs. Consequently, excretions must keep pace with the increasing amount of waste products. Hence sweating and loadening of the rectum and bladder result. The horse, when suffering from colic (or enteritis), sweats profusely, and the same holds with man. There is additional sensibility to cold, in pain, as also in excitement. There is evidence that pain may result in albuminous metamorphosis, especially of cardiac muscle. It is of interest to inquire if pain gives rise to an increase of the fibrin-factors in the blood. Should this be the case, it is easy to see how advantageous such a correlation between pain, very generally the result of injury, on the one hand, and the liability to rapid coagulation on the other, would be.

Those animals, in which the blood-vessels could be most readily occluded after being opened by injury, would apparently have the best chance of survival. An increase in the amount of the fibrin-factors in the blood might aid the occurrence of coagulation at the seat of an injury. In man the fibrin-factors are said to be especially increased in cases of rheumatic fever, and in other instances of painful inflammations. It seems possible that this is a case in point, and that the organism has, so to speak, mistaken the pain resulting from, or rather associated with, disease, for that which usually accompanies an injury.

Dilatation of the pupils concurs with pain. Dr. Gresswell recently noticed the pupils of a lad, suffering from

Peliosis rheumatica, to dilate whenever one elbow-joint, which was exquisitely tender, was pressed. He has observed the same occurrence in strong children undergoing tracheotomy, in cases when an anæsthetic could not be administered. The pupil also, in cases of locomotor ataxy, very frequently dilates, when an attack of pain comes on. Conversely, myosis is seen when the centres of sensation are dulled, though later, towards death, mydriasis sets in. For instance, there is contraction of the pupil in sleep, in opium stupor, the stupor of typhus and of enteric fever, and, it is said, in that of relapsing fever. Similarly, in the anæsthesia produced by chloroform the pupils contract, and later, when the stage of profound narcosis supervenes, they dilate. In the preparation for defence, for action, some animals show dilatation of the pupil. This is well seen in the cat. Moreover, in ourselves the pupil dilates, if sensory nerves be strongly irritated, also as an effect of excitement, and during severe muscular exertion.

Again, if a horse be suddenly put to work, inflammation is likely to occur over the crest of the navicular bone, *i.e.* over a part where leverage is afforded to the corresponding flexor tendon. Sudden extra action of the muscle is attended by an extra amount of friction there, and consequent inflammation. Similarly, the joints first affected in rheumatic fever are those most in use at the onset of the disease, and this holds in animals, as well as in man. The endocarditis of chronic Bright's disease is attributed to the extra blood-pressure, which, indeed, is one of the earliest manifestations of inflammation of the kidney. The value, then, of the subjugation of pain in cases of endocarditis, and in cases of pericarditis of rheumatic fever, may be to some extent due to the coincident soothing of the heart.

We see, then, that the infliction or presence of pain, due to whatsoever cause, arouses the associates of work, not only in health, but also in disease. Though in some instances the mechanism we have attempted to indicate may be strikingly shown for a considerable period, we must not forget that it may, by continued action, become, so to speak, "run down,"—that the sufferer may be exhausted, and then no longer able to manifest the processes referred to. A horse suffering from laminitis affords a good example of a case in which, although the animal becomes greatly exhausted, pain still maintains in vigorous action the associates of work.

Physiological processes, which are beneficial in that they work for good, may be represented more or less closely in disease, thus in some instances producing a vast amount of

harm. The constitutional unrest which is set up by the pain consequent upon an injury works mischief. A dog or a deer which has met with a fracture of the leg, and consequently suffers pain at each movement of the fragments, seeks quiet and darkness. Thus, the resting of the leg, the fasting, the general repose, the absence of disturbing influences, the darkness—all these factors lead to a diminution of the constitutional excitement.

Irritation.—We speak of irritation separately; for, though, when extreme, irritation may merge into absolute pain, we must still, for convenience' sake, draw a line between the two kinds of sensations. Irritation of the skin causes contraction of muscle, with the object, apparently, of removing the irritant. The more intense the degree of irritation may be, the more muscular tissue contracts to the same end. Many of the cutaneous diseases of animals cause them to bite and rub. In the primeval state it is possible that the greater number of skin diseases were traceable to different kinds of parasites, and hence the scratching might in some cases be more or less effectual. It is difficult to see how it could be of the least use as a rule, when the eruptions are not due to the presence of parasites. On the other hand, it is certain that it would be in many instances very damaging. Patients afflicted with erythemata or roseola itch, and also those suffering from the early onset of psoriasis. Itching is also characteristic of eczema, herpes, and pemphigus; each of the so-called papular inflammations; each of the rashes of the specific fevers. Children, suffering from scarlet fever and measles, sometimes beg to be scratched from head to foot. This has also been observed in teething in man and animals. Irritation then gives rise to scratching and rubbing; and, as we have indicated, although this may be useful when the irritant can be removed, it must be harmful at nearly all other times. Again, irritation of the conjunctiva causes contraction of the lids; that of the nasal mucous membrane causes sneezing; that of the throat causes attempts at swallowing; that of the rectum causes tenesmus, both in animals and in man. These are conservative. Inflammation of these structures, however, has the same effect more pronounced, and then the effect is by no means conservative. Similarly, an animal, suffering pain from internal causes, frequently bites, or even kicks savagely, the corresponding side, and in a part which has apparently a relation through nerves with the internal part affected. The relief which follows the application of one or more leeches, or of a small blister, to a painful part on the surface of the body, in cases

of inflammation within, is possibly to be in part explained by a similar nervous connection. Irritation may be intensified so as to be really nothing less than actual pain, and then all the intricate mechanism of work, of the fight, is called into action, instead of small portions of that mechanism. As instances we may mention the case of the thoroughbred when constantly worried by an insect. Similarly a sheep, after all efforts to dislodge the *Æstrus ovis* have proved unavailing, runs madly about, until well-nigh exhausted with fatigue. A man, too, may be irritated by the harvest bug, until he is in a semi-pyrexial state.

One particular association which we may say has developed as a necessity of evolution, *i. e.* in accordance with the law of causation, as expressed in the survival of the fittest, may be especially noted as persisting in the region of pathology, and working great harm. If a nauseous or irritating substance be swallowed, vomiting may ensue. If an irritant be applied to any part of the digestive tract, vomiting or defecation may occur. This is, if we may so speak, a wise though unconscious reaction, in certain cases an indispensable one, if the organism is to avoid death. It is best, in most instances, that substances which are nauseous or irritating should be rejected. Such reflex effect is therefore of supreme importance. It persists, however, under pathological conditions, when it does harm. So alive are the intestines to the reflex effect caused by irritation that vomiting may occur in enteritis, or owing to a compression of a portion of gut in a hernia, or, for instance, it is said, in the apparatus of Dupuytren.

Nay, further, vomiting occurs, if structures in close relation with the intestines are injured, *e. g.* in peritonitis, in compression of mesentery in a hernia, in biliary colic, and when tenesmus is excited by irritation and inflammation of the lower part of the intestines. In many of these cases the reflex effect is harmful.

This reflex effect is seen even in irritation of the fauces, and on the passage of a pencil a very short way within the anus of a child.

There is reason to think that the irritation of the throat is a part cause of the early vomiting in scarlet fever. Of 175 patients suffering from scarlet fever whom Dr. D. A. Gresswell closely questioned, 130 were unable to speak with certainty, as to whether the soreness of the throat or the vomiting took precedence, so closely related were these symptoms. Forty, however, distinctly asserted that the soreness preceded the vomiting.

Vomiting also frequently occurs at the onset of diphtheria and of smallpox, in which the fauces are attacked, and it often closely follows the onset of inflammation of the fauces.

Violent coughing may cause retching, due apparently to the irritation of a pellet of mucus which has been coughed up into the throat. Similarly, even teething often apparently causes retching in the horse. We may say, then, that the result of evolution is that an alimentary tract has been formed, which is peculiarly sensitive, and that while this sensitivity in many cases does good, it may in others work a vast amount of harm. We may also say that irritation, in like manner with pain, brings about, to a greater or less extent, the associates of work, and this not only in healthy animals, but also in those which are suffering from the abnormal processes of disease.

Timidity, Fear, Fright.—The sensation of fear, like the *excitement of the fight*, the feeling of *pain*, or that smaller degree of stimulation which we call *irritation*, similarly calls up the associates of work.

All gradations may be witnessed, in man and animals, between the ready action of timidity and fear and the inco-ordination and paralysis of fright. The rough handling of a nervous horse may cause palpitation audible at a distance. It may cause an irregular and intermittent beat. It may cause the beat to cease. "Polands" have died, it is said, of fear, when taken by surprise, as they easily are taken owing to the large size of the crest, which obscures their vision. In man, too, the paralysing effect of fright is well known.

Fear calls up the associates of work, the exertion needed for escape, or that of the fight. Fright is fear carried to such excess that inco-ordination, resulting, it may be, in paralysis, ensues. It was reported of Lefroy Mapleton, the murderer, that, on his way by train to gaol, as the people crowded at the window hooting and yelling at him, his face worked convulsively, his fingers clenched, and then opened, and his arms twitched in the grasp of his captors. He had the weary fearsome look of a hunted creature, and as he passed the people cursing and groaning at him, his brows more than once contracted, and his upper lip was raised, exposing the gums, and showing the eye-teeth pressed together. Fear called forth the associates of work.

Sympathy.—Sympathy occurs primarily, perhaps, in the family. The parent protects the offspring at the cost of its own life. Again, a hen may be tempted by the sight of a chalk

egg to lay, when otherwise it would not do so. Secondly sympathy prompts to associated action in communities, and it may lead at times to actions which good sense would not endorse. The first of a flock of sheep in flight may jump a fence, the next may knock it down; but the rest may, nevertheless, jump, as if the fence remained. Sympathy with action inspires action. Sympathy with failure leads to depression.

These associations are, moreover, seen in pathology. When a lad screams with pain, and his mother, suffering from neuralgia, declares she feels an additional pang, we call it sympathy. One miscarriage in a cowshed is very often followed by others, and the infectiousness, so to say, of miscarriages in humankind is well known. It is probable that, in some cases at least, such miscarriages may be explained partly in this way.

Pleasure.—Pleasure has extremes. One we call pleasurable excitement, joy. The other we call comfort. With the former there is associated the mechanism of action; with the latter rather that of rest.

Therapeutics.—If the above be true, then, of our therapeutic measures, those which excite to action and those which induce rest are most important. Among the former there are physical work, external light and heat, noise, food, out-of-door scenery, stimulants, tonics. Among the latter there are reduction of work, of external light and heat, of noise, and of food, sedatives, venesection, reduction of irritation, of pain, and of excitement (that of pleasure, but more especially that produced by fear). Tales of success excite and stimulate, tales of happiness cause comfort, tales of failure depress. In some cases of disease excitement is more easily induced than in health. Dr. Gresswell recently saw a boy in the convalescent stage of pneumonia, who was so excited by a noisy delirious patient in the next bed, that his temperature rose from the normal point straightway to 104.4° F. An hour and a half later, his temperature had fallen by 1.8° F.; and next morning at 8 a.m. it was 98.2° . It then oscillated up and down for seven days, after which it remained at the normal. So also a patient convalescing from enteric fever, if excited by pleasure or by fear, almost always expresses the excitement in a rise of temperature.

Further, the organic world exhibits a periodicity of action and rest in obedience to an external rhythm, and there is evidence to prove that hygiene and therapeutics must be directed with attention to these rhythms.

Retrospect.—In reviewing cursorily our foregoing remarks

on abnormal functional manifestations of evolution, we find that the organic processes or functions which are concerned in, and make up, what is called the state of excitement are, in reality, processes of work, of activity. The effects of irritation, however produced, those of pain, of joy, of fear, of any impulse to movement of whatever kind, must be similar one to another. Though, then, in disease we find phenomena corresponding with those of the chase and the fight, with the defensive measures adopted in fear and fright and so on, it is to be conceived that many of such abnormal processes may be explicable in some cases by the light we have attempted to throw upon them. Even death may result from excessive and unequilibrated action of the vital mechanism, as in extreme fear and intense pain. The gradual development of such correlated mechanisms and such associated functions as we have attempted to indicate and briefly describe, we may believe, was necessitated by the survival of the fittest throughout past ages. The fact we have endeavoured to bring into notice is, that associations, which may be primarily considered as physiological or normal, doubtless also explain many pathological phenomena. No doubt the various factors are exceedingly difficult to trace in abnormal functions, and the most noteworthy feature of all is perhaps that, while certain associated processes may have been, and may still be, of the very greatest benefit under certain conditions, they may none the less work great harm, so far as the individual is concerned, under certain other allied conditions. Similar causes produce similar effects. In one case the effects may be advantageous, while in another instance of a like, though not identical, nature, they may be extremely disadvantageous. In cases of rheumatic fever, and in other cases of painful inflammation, the fibrin-factors are said to be especially increased. Now, can we explain this fact by the supposition that the history of pain in the mind of the organism is associated with that of injury? If so, we have, as was mentioned above, a clear case in point.

Thus we may note that a reaction of inestimable value, under certain conditions, is one which not only can serve no useful purpose, so far as we can see, in other allied conditions, but even might impede and retard recovery to a very considerable extent, and so bring about even a fatal issue.

Pain may be said to be one of the most valuable aids to self-preservation with which animals are furnished. Though in some cases of pain, such as that resulting from toothache, it is not always easy to trace results which are directly beneficial, still it will in every instance be found, on careful con-

sideration, that the tendency of measures naturally taken to relieve pain must generally be productive of advantage.

The constitutional excitement aroused by pain resulting from injury is especially of incalculable advantage, in so far as it leads to the redoubling of physical effort, exerted with the view of overcoming an antagonist. Among ourselves, in these days, in ordinary times of peace, such excessive efforts would tend in most cases to be rather self-destructive than self-preservative. Everyone who thinks on the numerous and varied phases, presented by the different factors concerned in such questions, will recognise the probability that immense advantages might arise from studying them, that new means of treatment, hitherto unknown, might thereby be found.

Let us suppose that an animal is victorious over an opponent by means of the redoubled efforts which it made after having received an injury which stimulated its closing successful struggles. Now, the pain, still continuing, will be of further value in so far as it dictates local rest; but at the same time in many cases it will mainly be harmful by reason of the general or constitutional unrest which is still kept up, though possibly no longer necessary, as a result of the suffering still endured.

When the pain results from morbid processes, the harm done by the reactions of the organism is oftentimes excessive, while the benefit is reduced to a minimum, or indeed, may altogether be non-existent. Thus it is seen that, as in the case of ordinary physiological processes, so also in those which are called abnormal, certain remnants of what may be perhaps termed "antique customs" still remain to clog the wheels of more highly-developed processes. Just as certain rudimentary structures, not only useless but even harmful, remain in higher animals to interfere with the working of newly-shaped and newly-constituted organs, so too organisms may be said now and again to make huge and sometimes fatal mistakes in the processes by which they attempt to throw off the results of injuries, or atone for damaging and dangerous changes. The conditions, as a whole, are different, but yet a similar reaction is exhibited, although it can no longer be successful.

Again, organisms present phenomena which may be said to consist of two sets or kinds, the members of which work to a great extent in association. The one great aggregate of processes is concerned when the organism must obtain food, effect its escape from pursuers, or fight an opponent, when in short, it must exert itself to the utmost in measures

of self-preservation, which are of a directly active character. The other great division of functions is exemplified when these objects have been met, when the end has been achieved for the time being, or when the mechanism of activity concerned in the other set of processes needs rehabilitation and repair. These two well-marked associations of work and rest, developed and made in the natural healthy animal for the ordinary purposes of life, make a reappearance, so to speak, in the field of disease. When thus manifested, certain correlated processes of the one kind or of the other may, it is true, in some cases work for good. Probably, in the majority, they will be productive of harm, while in some they may actually kill.

CHAPTER VII.

The Advancement of Comparative Pathology, and its relation to Veterinary Science.

THE continuance of pre-eminence once obtained, equally with the initial gaining of supremacy, power, knowledge, by nations, by classes of a community, by individuals, obviously depends on strenuous efforts from day to day. In order that a renewal of prosperity may be induced, no stone should be left unturned, no kind of perseverance in work should be wanting. New and rich markets are being opened out, vast developments of commerce are on the verge of being made, gigantic redistributions of wealth have been, and are being, effected, the energy of the human race is being spent in every possible, every conceivable, way. Still immense fields are yet untrodden, still untold sources of power lie hidden; and yet large numbers of people can scarcely find profitable work for their hands or brains to do. Most abundantly is it clear that all who have the welfare of their fellow-creatures at heart should consider with the utmost care every means of advancement and progress within reach.

Opportunities of research into the mysteries of life and disease, hitherto impossible, are open to investigators of the present age. Rich and inexhaustible stores are at hand, all ready to yield themselves up. With painstaking

labour, love, new worlds are being made to disclose themselves. Man is now peeping through dim apertures, gradually widening crevices in the dense walls of ignorance. He now sees, as in a glass darkly, truths previously hidden.

In times of on-coming bustle, stir, and activity, it is of paramount importance that men should select as fields of work those which are the most desirable and needful to cultivate. Surely we must avoid working in such a way or on such sterile soil that the energy expended would be largely wasted.

If we cast a glance at the history of science at large, we see that its gradual growth, in accordance with external factors, in correspondence with the various involved conditions to which man's intelligence has been subjected, furnishes in itself one of the best instances which can be adduced of the general process of evolution. To none of the particular branches of research does this apply more strongly than to the science of comparative pathology.

The discoveries of this century have truly been great, marvellous. Yet, wondrous as they are, still greater discoveries lie before us. A most important epoch in the history of science has been marked by the promulgation of the germ theory of disease, and by its subsequent elaboration. It would be impossible to exaggerate the importance of the influence exerted by recent discoveries on preventive medicine, and on our knowledge of the best modes of treatment of disease. Information is being daily gained which is destined to revolutionise the sciences of medicine and surgery. Vaccination, the germ theory and its implications, antiseptic measures, the inoculatory methods which have been found so successful in the hands of M. Pasteur and others, certain most important new lines of medical treatment—all these initiations of recent times are most intimately connected one with another. The microscope has revealed to us a world of micro-organisms, formerly hidden. Thus we have been enabled to look upon the phenomena of zymotic diseases in particular, and of the abnormal processes of organisms at large with the aid of the light thrown upon them by a generalisation of untold value. For the observers of this century, perhaps for those of the next few years, it has been reserved to clear up mysterious connections involved in disease and death, connections which will all blend and mingle to form one great whole, one science of pathology, as explained by the idea of gradual evolution.

The "poison," or "virus," or "contagium" of many of the specific fevers of man and animals, multiplies, when favourably situated, in a marvellous and rapid manner. It has been demonstrated that many diseases, for example, glanders, cattle plague, splenic fever, swine fever, tuberculosis, are due to the presence of small vegetable organisms of microscopic size in different parts of the animal's body, the blood, the lymphatics, the tissues, the organs. Doubtless we may infer that renewed and more searching investigation will lead to a similar conclusion respecting the causation of many diseases affecting man and animals, as yet not thus explained, as yet not thoroughly understood.

The investigation of the diseases of lower animals falls to the lot of the comparative pathologist, to the bacteriologist, the physician and the surgeon.

It is most gratifying to know that those who are able to speak of the present position of veterinary science, a branch of research destined to become, and now becoming, one of the strongholds of progressive pathology, are struck by the relative prominence which this department of knowledge is at length justly assuming, despite the many obstacles which still remain to oppose its advancing tide. Our means of combating and preventing the diseases of animals have gradually and definitely grown, and are growing.

From whatever point of view we may scrutinise the many important bearings of veterinary science it must be allowed that, apart from the direct services of the veterinarian to the owner of stock, the indirect advantages accruing to the community through his aid are ever to be borne in mind. The study of the normal and abnormal functions of animals, and of the various methods and therapeutic appliances by which perturbing factors can be counteracted and a disturbed vital equilibrium can be restored, is one which yields to no other in value and importance. In many different ways, both direct and indirect, the progress of the art and science of veterinary medicine and surgery conduces to the well-being of the community.

Of the many diseases of lower animals there are not a few which are directly communicable to man. Hence, knowledge of good therapeutic and preventive methods suitable for animals is of infinite importance to mankind. The dread malady known scientifically under the name of tuberculosis, and popularly as consumption, is widely prevalent among oxen, and from them is not improbably communicated to

the human body by the medium of the milk of infected milch-cows suffering from this terrible gerin invasion. It is of the utmost importance that vendors of milk should be prevented by severe repressive legislation from selling milk obtained from cows which are badly diseased. Indeed, it is quite as necessary as is the prohibition of the disposal of flesh unfit for human food. No doubt of late years there has been a great improvement in the condition of cowsheds. This is, so far as it goes, highly satisfactory; but it must not be forgotten that a very great deal remains to be done by the various sanitary authorities. Indeed, that most important article of diet, milk, is in several different ways liable to be a source of danger and death.

The germs of scarlet fever, diphtheria, typhoid fever, and probably many other diseases, may, through the agency of milk, spread desolation far and wide.

It is possible that the germs of disease may arise from the access of the emanations of patients, or they may be introduced by means of the addition of water, into which a portion of the infected excreta has been accidentally introduced owing to faulty drainage or other death-dealing conditions.

In addition to tuberculosis there are many diseases of lower animals which are known to be directly communicable to man. Hydrophobia, glanders, scarlet fever, anthrax, may be mentioned. There is no difficulty, then, in seeing that measures adopted to prevent the spread of devastating scourges among animals must be also highly conducive to the public health. The dreadful malady known as wool-sorters' disease, which affects man, seems to be identical with anthrax. The two Rabies' Orders recently issued by Her Majesty's Most Honourable Privy Council have especially been of great utility. A diminution, or, better still, a complete stamping out, of such a virulent disease as hydrophobia could not be too highly esteemed. The measures taken, both in this country and abroad, with this view, are of inestimable value.

Those who have seen this terrible scourge either in man or in beast must have hailed with strong feelings of satisfaction the appearance of the provisions recently enacted. To watch a fellow-creature tortured by phantom sights and fears, gasping in horrible paroxysms of agony, dying of rabies, is to look upon a spectacle which can never be forgotten.

Passing now to the Anthrax Order, we may note that the

advisability of thoroughly draining fields, or rather localities, in which anthrax is liable to break out from time to time, might well have been insisted upon, since this measure has been found to remove, in very large degree, such liability.

It seems to be now clearly established, almost beyond doubt, that we must look in the outside world for the origin of the germs which produce various maladies in man and animals. The different kinds of micro-organisms require certain conditions for their growth and development. In many cases damp is associated with putrefactive changes, which generally follow upon it. Such putrefaction and decay are the results of the vital processes of certain micro-organisms. It is not difficult to see how an animal, already suffering and debilitated from the more direct results of damp and cold, and partially famished by the absence of fresh nutrient material, may readily become a prey to the attacks of these minute and readily-multiplying organisms. They may be introduced by means of the lungs, alimentary canal, or may gain access to the blood through any abraded surface. In the course of ages, particular kinds of bacteria would tend to become more dangerous than others in the case of some of the various groups of animals respectively. In such a way as this we may suppose that the origin of certain diseases is to be explained.

The life-history of septic micro-organisms outside the animal body is as yet not well known. That they are modifiable by alterations of temperature, and by differences in the medium to which they are subjected, has been clearly established. There are some bacteria, for instance, which under the influence of certain conditions of this kind, produce definite pigments. It is still a matter for doubt, however, if an innocuous micro-organism which is known to be present in certain putrefactive changes, can, under any conditions, acquire the power of multiplying in an animal, and thereby producing an infectious disease. Dr. Hans Buchner claims to have transformed the common bacillus of infusion of hay, called the hay bacillus, into the *Bacillus anthracis*. As a rule this hay bacillus is a rod whose ends are more distinctly rounded, while those of the *Bacillus anthracis* are straighter. The hay bacillus is half as thick as the *Bacillus anthracis*. Again, the former is motile, possesses a flagellum, while the latter, the *Bacillus anthracis*, is not motile, and has no flagellum. In other points, the two kinds of bacilli seem to be absolutely distinct, and Klein considers, from his long course of elaborate experiments, that one might

as well attempt to transform the bulb of the common onion into that of the poisonous colchicum, as try to convert the hay bacillus into the *Bacillus anthracis*.

Klein concludes that there are some definite micro-organisms which as a rule exist and grow in various substances, and also possess the power of growing and thriving in the bodies of certain suitable animals, producing a definite pathological condition. "Just as there are species of plants which act as poisons to the animal body, and other species of plants which, although belonging to the same group and family, and although very much alike to the others, have no such power, and cannot acquire such power by any means, so there are micro-organisms which are pathogenic, while others are quite harmless. The latter remain so, no matter under what conditions and for how long they grow." ('Micro-organisms and Disease,' page 230).

It is indubitable that thorough cleanliness and drainage—in short an accurate and most careful attention to the laws of hygiene, must, and will, gradually bring about a great diminution in animal plagues. The removal of all tendencies to wet and putrefaction, cannot but be of inestimable value. There can be but little doubt that ague and other malarial fevers are due to the prevalence of miasmatic germ-containing vapours arising from ill-drained or marshy lands, on which the vegetation is undergoing putrefactive change. On these grounds it is to be regretted that no mention is made of the necessity of drainage in the Anthrax Order. One more omission should be remarked. It is that horses which are liable to attacks of anthrax are not expressly included in the Order. Possibly this may be looked upon as an oversight which may be compensated for without any difficulty. However, though these two points are noticed, it is with no view of disparaging an Order whose provisions will be productive of incalculable advantage to stock-breeders, cattle-owners, farmers, and in short to the nation generally.

Progress in veterinary science leads directly to the better management, to the general welfare, to the alleviation of the sufferings and maladies of the domesticated animals, increases our power of resisting great loss of wealth. It would be impossible to over-estimate the importance of this immediate result. Not only is it true that there is obtainable a more abundant supply of food, in so far as the diseases of oxen, sheep, pigs, and fowls, and so on are diminished; but to this great fact is also to be added the other no less noteworthy one, that by means of well-

adjusted curative measures, the general meat supply is rendered more wholesome and more valuable.

In past generations errors without number, sources of unbounded evil, have soaked into the minds of the people, and now the exposing and uprooting of them is a slow and tedious process which still bars our onward path. One of the most lamentable and mischievous notions regarding the diseases of man and animals is that certain curable derangements are incurable, and certain preventible maladies non-preventible. It is a fact that very many cases, perfectly amenable to treatment, are not properly taken in hand.

There is no doubt that much valuable stock is still lost, owing to the fact that the owners will not have remedial measures employed. In many cases this is the result of a false idea of economy; but in the majority of instances it is rather due to an ignorance of what remedial measures can be carried out, and sometimes the neglect arises from sheer carelessness or cruelty. Sometimes a large sheep-farmer will allow a great number of animals to die, before calling in good special advice. Even many horses or oxen are not seldom lost owing to want of attention and careful treatment. Unfortunately it is not unfrequently the case, even in these days, that horses are purely and simply poisoned.

It is undeniable that some owners of valuable studs, not only use the numerous quack remedies, but in some cases even entrust the medicinal treatment of their suffering animals to the tender mercies of stable attendants.

The strange delusion is still held in some quarters that an uneducated man, by dint of prolonged attention to a horse's ordinary daily wants, not only acquires, by a kind of process of imbibition, a knowledge of the animal's circulation, respiration, and digestion, excretions, secretions, nerve-impulses, and so on, but is also, by a miraculous intervention of nature, supplied with correct ideas as to the influence of drugs in various doses, and other therapeutic appliances, for which a large part of a lifetime's study and devotion is, in reality, necessary.

Two maladies, generally supposed to be incurable, in reality amenable to careful, judicious, and scientific treatment, may be mentioned (J. B. Gresswell).

Actinomycosis is a disease which usually manifests itself by the growth of tumours in the tongues of beasts. This malady, which is caused by a fungus, and has been widely prevalent of late, is, at any rate in many cases, curable. In

man the disease is of rare occurrence. Again, lockjaw or tetanus is a very common disease among horses. Frequently it is amenable to judicious management; very many cases of cure have been recorded. Now, in man tetanus is not nearly so prevalent; but it generally proves fatal. Many practitioners of human medicine would not hesitate to say that it is generally incurable. In such an instance as this indications of treatment can be gained from the field of veterinary medicine. There can be no doubt that great discoveries are yet to be made, that potent curative remedies still remain to be found. Veterinary surgeons have exceptionally favourable opportunities of research.

Again, who will say that the horse, that noble and most invaluable animal; the dog, man's faithful servant and useful companion; the camel, who tracks for us the arid wastes of the desert; the elephant, the ox, the sheep, the pig, the fowl, and other animals—all those creatures, in short, which serve our wants and purposes in any way, do not one and all merit sincere attention when stricken down by grievous maladies? Herein is afforded a vast field for research into the nature, causes, and treatment of disease in general. Already the veterinary art has done a great deal. Who can say what immense stores of knowledge will be at hand in the future? By clearly understanding the phenomena of disease, as presented by those particular members of the class mammalia so nearly related to man himself and trained to his use, and by other animals, we are enabled to obtain a wider and more scientific grasp of the facts of disease in man than could be in any other way acquired. The numerous facts known or readily accessible must be rightly applied. The light thrown upon abnormal processes in general by a study of the diseases of lower animals is already very great.

No words can be found to adequately express the extreme value, the transcendent interest of the study of comparative pathology. The importance of both its direct and indirect utility is not as yet realised, even in a dim degree. As yet, in common with its twin sister, comparative therapeutics, this branch of knowledge is in its earliest infancy. Verily, the harvest is plentiful, but the labourers few. Just as the elaborate science of morphology has arisen out of the crude anatomy of bygone days, so must the true science of pathology be evolved from the basis of our present knowledge, which may be regarded as the starting-point from which we may see a dim vision of a goal. Scarcely more than glanced at as yet from a wide point of view, pathology has neverthe-

less already told us a great deal. It is only recently that the firm establishment of the doctrine of evolution as a relatively true and fundamental basis of thought and fact has led to attempts to unravel by its aid the varied and mysterious facts of disease.

As a provisional explanation of the mode of development of organisms, in the case of the tribe as in that of the individual, and in many other ways, the evolution hypothesis has been incalculably advantageous. The benefits hitherto derived are, however, immeasurably enhanced by the importance of the light which is now being thrown upon vital processes, both normal and abnormal, by those who are, whether consciously or unconsciously, now being guided by the idea of evolution in their methods of research. In every department of knowledge this theory is exerting the very greatest influence; but there is no science, which is destined to be so profoundly and radically affected for good by it, as is that of comparative pathology, the only true and rational science of disease. It must be held a primary and fundamental assumption that, just as all animals have presumably had a common origin, in like manner all functional and structural disorders present connections of the very highest interest and importance one with another. In short, the phenomena of disease are to be studied from the comparative aspect, no less than by their special manifestations. This is a point of view which men of light and leading are now applying with the best results. Herein is opened out a new field for investigation, which in the very highest degree demands cultivation on account of the wondrous usefulness of the knowledge which is to be gained.

CHAPTER VIII.

The Place of Physical Science in Education and in Human Life.

“O gentlemen, the time of life is short !
To spend that shortness basely were too long.”

Shakespeare.

“O mare, O litus, verum secretumque Mouseion, quam multa dictatis, quam multa invenitis !”—*Pliny.*

“O sea, O shore, veritable and secret home of the Muses, how many virtues ye inculcate, how many mysteries reveal !”

By those who accept the doctrine of evolution as set forth by Mr. Herbert Spencer, whose teaching we have, in the main, attempted to follow in the foregoing chapters, it will not be thought strange that, in continuation of our subject, we now propose to show how transcendently important is the study of natural science.

There can be no doubt in the minds of those who accept the general idea of evolution, that a far-reaching grasp of the principles implied by such recognition can only be gained in a thorough manner by the practical and scientific observation of natural phenomena. If the theory of universal causation be true, as we maintain, then it is necessarily incumbent upon us not only to teach it as a theory, but also to show how all surrounding processes, all observed phenomena, including those which make up our own lives, are regulated in accordance with such causation. Probably no one will dispute that the end and aim of education is the instilling, not only of correct ideas themselves, but also of the power to form true conceptions of an original character, into the minds of those who are taught. If such power is possessed, then we may look for able research in divers departments of inquiry on the part of the possessors. True methods of reasoning must, and will, tend to impart the power to see the kind of experimentation that is required, the correct manner of prosecuting an investigation, the ability to decide problems, in relation to which the evidence seems to be conflicting, the right kind of conduct in peculiar and difficult cases, where good and bad must be accurately balanced and weighed. In short they will, by virtue of their

very nature, impart to the mind of the reasoner all those qualities and faculties which are most needful and best. Such processes of mental procedure can, we believe, be only properly acquired by the practical study of the natural sciences.

The subject of this chapter opens up many side issues, and is, indeed, one of the most important of all the subjects which have been, and still are, exercising the public mind. It will be our object in this place merely to touch upon some few of the many points of view from which the subjects of training and culture may be approached, just to indicate, in short, some of the more noteworthy ideas connected with the topics under consideration. A thorough and complete investigation would not only be impossible on account of the limitations of space, but also manifestly out of place in this work, since the special questions which would arise for discussion are only distantly and indirectly connected with ideas of evolution.

The suitable and right training of the young, of those who are destined to play parts more or less prominent in the business of a community, the fostering of a spirit of true culture and intelligence, the formation of that philosophic habit of mind invariably resulting from a liberal and sound education and from a course of wide reading, coupled with the habit of accurate observation—these are not the least among the primary duties of mankind. In fact the subject of education is one which yields to no other in importance. It may be said, indeed, that to train our children correctly comes second in point of urgency only to the necessity of providing them with the requisites of healthy life.

Whether we hold that the Government of a country should employ direct means to secure the right bringing up and care of the minds as well as the bodies of the young, and, if so, what the nature and extent of that direct method should be, or whether, on the other hand, we are disposed to believe that the governing powers should not directly interpose and interfere, all must agree that one great aim of every nation should be to foster to the utmost the spirit of culture and research.

This being so, those who are practically engaged in the work of education feel that they are right in asking for, and even, we will add, justified in demanding the interest and influence of all.

The great differences of opinion on this subject of training, and the widely divergent views of those who have had years and years of practical experience in teaching, constitute

sufficient evidence that men have at least been convinced that there are still presented for solution major and minor problems of the greatest difficulty. Indeed, it needs but little exemplification to show that much advance must still be made in our methods of tuition, and especially is there need for light in the choice of subjects and parts of subjects to be taught, in order that there may be the least possible expenditure of time, and labour, and friction, in bringing about a knowledge of the most essential principles, and the chief facts which support such principles, on the part of the pupils. It has been insisted that it should not be our object to lessen the difficulties encountered in the process of learning. Only a little consideration, however, is needed to show how erroneous this view is. It is doubtless true that facts which have been easily learned place the learner on a vantage ground, the importance of which he or she is apt to under-rate. Yet we must remember that this argument would apply to everyone born at this epoch, inasmuch as we are all "heirs of past ages." It would obviously be impossible for us to realise, even in a dim degree, the labour that has been done for us by our progenitors. Further, they too had advantages bequeathed to them in like manner, and, unless they had possessed them, recent discoveries could not have been made. To those who are sanguine and optimistic in their views—and it is one of the best signs of the times that men are holding up their heads with firm and determined will at this time of temporary yet most severe depression, despite the reiterated doctrines of pessimism—it will ever be manifest that, however great have been the deeds done in the past, their magnitude and importance are as nothing when compared with the discoveries which await us. Realising this, they will never stint any and every aid which they can supply to those who are about to carry forward the same great work in which they are themselves so nobly engaged, and they will also try to atone for the slight loss which may here and there perchance result from what may appear to be a too easy learning of principles and facts which they, the teachers, had necessarily greater difficulty in acquiring, by instilling even more of that enthusiasm and love of the work and of the truth than they perhaps themselves were always able to keep up. It must be clear that, when those difficulties which are avoidable have been cleared from the path of the travellers, they will journey onwards with a lighter heart and a freer step, and a greater power of removing those obstacles which still stand so firmly, and so mockingly embarrass man's best and most enduring efforts. For the workers of this and the next

generation there are many thorny thickets to be battled with and cut down with the sharp and keen axe of the human intellect, aided in every possible way that striving men can devise. If this applies to the cultured worker, how much more does it affect our conceptions regarding the teaching of the young!

That there is very much room for improvement in current methods and ideas relating to the great subject of education of all classes and degrees of students, men seem to be universally agreed. Above all things it is a most serious question if we are right in these days in giving such decided preference to the study of language, the organised embodiment of the symbols of our thoughts, or whether we should not rather, in the first place, impart instruction respecting those realities which underlie words, the mere counters and representatives of things and of thoughts. Surely on reflection it would rather be decided that, inasmuch as words are, at best, but very imperfect modes of expressing the things symbolised by them, the study of Nature herself should be our primary and chief object. We ought, so far as is possible, to have recourse to the study of natural phenomena and natural objects themselves, to Nature's true coins, unadulterated and undefiled. With this point in view, we ought to consider it a duty of paramount importance to reiterate and ensure, so far as our power will extend, that physical science, the most important and yet most neglected of all studies, should be efficiently and intelligently and practically taught in every educational institution, both to female and male students. We would lay stress on the word *taught* as opposed to the principle of examination, since there can be but little doubt that examinations, when carried to excess, so far from encouraging original research, probably do more than any other necessary evil to retard and deaden and prevent real and living interest on the part of the students of this generation.

The deep chasm which separates language on the one hand from facts as we know them on the other, an antagonism, so to speak, upon which it is impossible to lay too much emphasis, is but one instance out of many which might be adduced of that universal contrast between all symbols employed by us, of whatever kind they be, on the one side, and natural phenomena on the other. Unfortunately it is clear that this contrast must always inevitably result from the narrow limitations of our intelligence and of our consciousness. It may be said that the excessive use of fine words, of beautiful phrases, of

enchancing metaphors, in short, the employment of "word-painting" is, in reality, rather a beautifying accessory and an adornment of poets and philosophers, and not so much an actual necessity for the mounting of those steps of real knowledge, whereby we hope to arrive at the interpretations of the many mysteries presented to us in this world. Far be it from us to disparage the noble works of the great writers. They have made Nature herself seem ever more gloriously resplendent by their lavish praise of the varied garbs she is bedecked withal, and they have done far more than this. It is not to be gainsaid that poetry and polished prose, and painting, and music, and sculpture have wondrously improved and perfected the faculties of imagination and observation, once dormant in the uncivilised mind. It must be confessed that the extensive use of words, carried almost to the verge of worship, has greatly developed human modes of thought. While, then, nowise presuming to despise the crutches by the help of which good thinkers and lame thinkers alike are compelled to advance, let us never forget that the facts, the natural phenomena themselves, must always be recognised as of primary importance, and, at least with regard to the question of education, let us no longer offer sacrifice at the shrine of words, no longer inhale the incense of the Temple of Symbols!

It is instructive to glance for a moment at the necessarily slow and gradual nature of the processes which have culminated in our present powers of speech and language. It is manifest that man, many long centuries ago in the world's history, was, in his first stages of mental growth, capable only of observing with rough readiness the phenomena going on around him, and at such a period he was only capable of communicating to others what ideas and sentiments he possessed, by means of the crudest symbols of vocal and facial expression. As we have said before, it was by gesture in great part that feelings and thoughts were expressed in the earliest times of which we possess records, and we also pointed out that so great was the confusion existing in the blurred mental vision of the primitive races, that the same word was employed to symbolise ideas exactly opposite to each other in point of meaning. From such rough and rudimentary beginnings, modern languages have been derived, ever growing, like all things else around, gradually but surely in accordance with all the conditions at work. The results are those complex vehicles of communication betwixt man and man which we call languages, and no doubt, as mankind progresses, there will yet be slow

but great and sure increases in the breadth of insight, the extent and the accuracy of the ways, and the materials of human speech. The development of language is doubtless still going on amongst us.

It is obvious that a certain degree of exactitude in observation and of intelligence must have preceded the definite power of conversing intelligently one with another.

It is clear, then, that the power of observation must have preceded speech in the history of the human race generally, and also in that of each individual in particular, and similarly we ought rather to inculcate excellence and accuracy of perception in regard to things themselves than, in the first instance, and at the outset, to be so eager to strive to make perfect in the use of words. The power of accurate observation should first be taught. Such capacity should take precedence in order of importance, since skilful adroitness in the use of words is of less value, if it be not backed up with practical knowledge, and indeed also less perfect. It must not be forgotten that the best language implies not only the best reflective powers, but also the best observational faculties. The savage and the uncivilised are, it is true, exceedingly alert to those particular aspects of the events occurring near them which bear directly upon their own immediate safety and advancement; but they are marvellously blind to many of those beauties and phases of wondrous changes going on, which to the cultivated mind would appeal most irresistibly. An ordinary rustic will note the characteristics of the crops as he passes by them in the train, but he will very probably fail to remark the picturesque calm of the landscape or the amazing splendour of the sky, lit up with the quickly-varying hues of dawn or sunset.

Nevertheless, it is true that the man or woman who lives on books and thought will by degrees lapse into a state of mind favourable to the use of words, but averse to the habit of observation of facts and things. Moreover, if this tendency is intensified in one or two generations, the probability is that both kinds of power will have vanished. Indeed, never should it be forgotten that the health of the mind depends upon that of the body, and this everyday common-sense fact, in these days of empty cram, requires to be shouted from every housetop, and dinned into the ears of all blind leaders of the blind.

The power of writing well is a great and wondrously alluring acquisition; but, when men try to impart this gift to others, they should ever remember that its most important essential condition is a solid basis of actual fact.

To the reflective mind it cannot but be a sad conclusion that we are debarred from forming other than narrow conceptions of things as they really exist, shut out from an ultimate explanation of the meaning of life and of the universe. Now, if things as they seem to us can only be most imperfectly represented by the various symbols we employ, how much less possible is it for us to express in words those unobserved but actual facts which we do not see! We begin by observing a given thing, and we then express in words the result of our mental picture. There are therefore two distinct sources of error; for, firstly, the vision is imperfect, and secondly, our verbal representation of the vision itself is incomplete and erroneous. Nevertheless, in using words it is our avowed object to represent the most accurate and exact pictures which can possibly be made. That we are not insisting upon a small point will be manifest to anyone who will put it to the test.

Two factors, then, may be distinguished as contributing to the necessarily limited human capacity in the expression of facts by the use of words. In the first place our inability completely to understand the events occurring, and the things existing, around us, must ever be an insurmountable obstacle to our forming correct conclusions regarding them and their causation. Our intellectual powers being so limited as they are, it is impossible for us to grasp in their entirety the highest truths. Furthermore, the words, phrases, and methods of verbal representation we employ as symbols are too cumbersome, too imperfect, and too inaccurate to always admit of exact use. In short, while on the one hand the knowledge we possess is sadly deficient, the words we employ as the means of its diffusion, based as many of them (owing to their genesis) are on imperfect ideas of things, are themselves also still more defective, ambiguous, and misleading. The second drawback has resulted, and does result, from the first, at least to a very large extent; but it is obviously of sufficient importance to need special mention, since it is only by fully realising that our language at its best is but an imperfect instrument of thought that we shall be likely to strive to be as exact and accurate as it is possible to be, in the words we use to convey our meaning.

It is then indubitable that our modes of thought and our methods of expression are both alike as yet very far from having arrived at any near approximation to that perfection which, even if not theoretically conceivable, may be regarded at any rate as a legitimate and justifiable aim.

The truth must be admitted that what we think we see,

hear, and feel—our impressions, in short, are to be received in a critical spirit and with the greatest caution.

At the same time, though we can never really know how far our conceptions and impressions are true, still we are compelled to accept them in a general sense as having a degree of relative and provisional accuracy which, it should be remembered, varies to a great extent directly with the efforts made by ourselves and our progenitors to obtain it. It cannot but be a familiar fact that the senses are apt to deceive with blurred images, and none the less generally remarked is it that the mental horizon of the uneducated is far less wide than that of the most highly cultivated among us. The happy ploughboy, who, in rustic felicity lazily sitting on a gate, his legs slowly swinging to and fro in rhythm with the tardy actions of his brain-cells, or, it may be, reclining on a heap of sweet-scented newly-mown hay, anticipates with stealthy satisfaction and glee the blissful moment when his mouth, opening wide, shall shortly prepare itself for the reception of that large morsel of bread and bacon he has just prepared for this purpose, dreams not of higher things. And though the cultivated student of Nature's great and wondrous charms offers a striking contrast ; as :—

“ With thoughts perturbed and many a sigh,
He knows as all things else he too must die,
But hopes his soul is not mere clay
And only meant for life's short day,”

still he too must acknowledge that he is often led far astray from truth. It seems almost superfluous to give instances ; but this well-known and universal experience of inadequacy of true insight may receive rough-and-ready exemplification in the apparently greatest size of the sun at sunrise and sunset, in the seeming smallness of mountains when viewed standing out behind some comparatively diminutive objects, such as trees and buildings, and in the fact, so well known, that the higher of two mountain-heights frequently offers the appearance of being the lower.

One can scarcely believe, for instance, on first comparing the Devil's Peak with Table Mountain while standing in Rondebosch,* that the latter is in reality of greater altitude than the former. And though in such cases as these, ready explanations are at hand, in general it may be said to be indisputably true that the very nature of our consciousness

* One of the delightful and picturesque suburbs of Cape Town, whereat in the Hall of the College situated there, these remarks were delivered in the form of a public lecture, by the Author, on February 7th, 1884.

prevents and precludes all proof as to the value of our impressions, of our inductions, and of our deductions.

The deep-lying inadequacy of our received modes and our accepted results of the representation of realities may in numerous ways be illustrated. What picture that was ever painted, splendid though its colouring, all but perfect though its delineation, be, has ever displayed, or can ever display, the wonderful beauties of Nature's grand scenery? Who can fail to see the vast difference, the immeasurable gap betwixt our picturesque surroundings, and their symbolized forms on canvas?

What painter has the intrepidity, and the boldness to say, "Look, and see Nature herself here faithfully depicted?"

What song of war, or love, or woful misery, what feigned passions or acted hatred, can move us as the spontaneous outbursts of fierce animosity, of biting sarcasm, of vehement denunciation, as the natural impulses of blind, unthinking, and unreasoning affection? What sculptor can recall Nature's perfect charms? What actor or actress, clever and talented though he or she be, can convey to our minds in their strongest intensity of feeling the meaningless prejudices, the causeless repulsions, the fond attachments we experience from day to day?

What work of architecture, what cathedral, howsoever grand the inspiration which prompted the rearing of the edifice, towering in our imagination even beyond the clouds and beyond the world, however great and successful the conception of the author to represent in stone the conflicting emotions which possess us, our vain but wise attempts to grasp the unknown,—what magnificent building of man can thus artfully equal in grandeur, or approach in beauty, that wondrous symmetry blended with perplexing asymmetry, open to our gaze in the marvellous works of Nature all around?

Far be it from us to ignore that much can be, and has been, achieved. That great things have been done is not to be lightly esteemed; that our conceptions of Nature herself are thus widened and their scope enlarged by such artificial efforts to delineate her features, must be fully recognised; but that there remains, and ever will remain, an unpassed and impassable gulf between the natural and the artificial, between phenomena and our attempts to recall and realise them, is at once palpable and inevitable. For us, guides and landmarks are necessary. We must have definite limitations and boundaries, and where they do not exist we must

find them or create them, we, who are perforce compelled to picture Nature in the form of Art.

But always, and above all in our dealings with our fellow-men, let us remember that

“One touch of Nature makes the whole world kin.”

It is possible, nay even probable, that all our impressions of external things are nothing near the absolute reality of truth itself. Though, however, our powers can manifestly never be perfect, they can be largely improved by application. It cannot but be familiar to all that, the more we give our attention to observation, the more accurate will our powers in this respect become. We know how people differ with regard to their impressions of the external world, and that such differences are in great measure attributable to the character of the training they have undergone.

We cannot but believe that men are at present very, very far removed from the attainment of any degree of perfection. Although, however, we know that men can learn far more than at present they are acquainted with, still we have no grounds for believing that we shall ever be in reality perfect in this respect. Such a power is altogether outside the range of our imagination. It is absolutely and completely inconceivable that we could ever possess it. It is manifest, then, that the impressions made upon our brains by natural phenomena are to a large extent incomplete and imperfect, and though they can be largely improved by continued use, and hard work, and application, it is inconceivable but that there must always remain a region beyond which we can never hope that our unaided intelligence can penetrate. If our impressions themselves are imperfect, as we have endeavoured to show that they are, how much more so must be our symbols !

Inasmuch, then, as facts, natural events, must precede our impressions of them, and further, since our symbols of impressions must be preceded by the impressions themselves, it follows that there must be a great gap in point of perfection firstly between the natural events themselves and our impressions of them, and secondly between our impressions of them and the manufactured and necessarily artificial symbols we employ to represent them.

Since such is the case, how evident it should be that, as facts must always precede their representations, as they did in the highest degree during the early stages of human life, so should in this day also the study of facts precede that of words.

Surely the first study in order of importance, then, is natural or physical science.

On the other hand, it is not to be forgotten that, just as a thoroughly good musical training is required to produce the power of appreciation and true mental interpretation of complex harmonies and trains of sound, so, too, it would seem that an efficient education in the classical languages is required to bring out a thorough knowledge and appreciation of good writing.

It cannot be too much insisted upon that education must always be based to a large extent upon the imparting of a thorough knowledge of, and proficiency in, the employment of words and phrases.

This can be effected by means of instruction in the classics, though it must be remembered that a knowledge of classics, and that knowledge of our own language primarily based upon these languages, which the experience of men for a long period of time would seem to show is most easily thereby gained, can only be of great value, so long as languages based upon the classical languages continue to exist. For it must be obvious to all who believe that man is progressing, be it rapidly or be it slowly, that the language to be used in the future must necessarily be far superior to, and very different from, any language of present times.

Thus it would appear, as Mr. Spencer so forcibly points out, that science should precede language and all other studies whatsoever, inasmuch as its subject-matter must, so far as we can imagine, endure for ever.

Not forgetting, then, that while it is of the highest importance that everyone should be thoroughly grounded in his or her own language, and that, at each advancing stage of progress, a still more complete knowledge of it will be required, since, as time goes on, it will become more and more necessary, for those who wish to be pre-eminent and to excel, to be able to communicate with others concerning the most complex ideas and facts in the best and shortest manner, still we have come to the conclusion that while the study of language is most necessary for all, the pursuit of science is on the whole of most paramount importance, and, indeed, that the attainment of the highest possible excellence, even in language, will rather be achieved by considering it rather from the truly scientific aspect than from that narrow conception of it which is common. We would further maintain that the pursuit of that branch of science generally designated physical or natural science is most calculated to best ensure the correct and exact spirit of general scientific culture.

It truly seems strange that in spite of the earnest manner

in which Bacon insisted upon the necessity of science, in spite of the eloquent language he used in favour of it both in the 'Novum Organum' and in the 'Advancement of Learning,' in spite of this, and in spite of all the other numerous circumstances which might have been expected simply to revolutionise modern methods of education, it has been only in quite recent times that men have begun to gain a dim appreciation of the value of natural science. Strange to say, the ignoring of science in education prevalent throughout the last century and the greater part of the nineteenth century, was quite a novel iniquity, since it was very generally taught in the earlier Middle Ages.

In these modern times see what an effect the revival of science in our educational schemes has produced ! It may be said to have completely changed the manners and customs of schools, and it has brought about a far more human, a far more kindly, a far more truly Christian, spirit, in place of that brutal tone which formerly prevailed ; for science, be it remembered, is a great moral educator, and has done much to foster a spirit of true religion among mankind.

Let us turn for a moment to the other side of the picture. The painful ignorance respecting the most crude and rudimentary scientific ideas which even now generally characterises so many of the so-called educated and highly cultivated is sometimes almost ludicrous.

Of those who have had no educational training of any kind in natural science it is only individuals possessed of exceptional originality and studious habits, in short of powers of intellect and of deep thought far above the average, who have any knowledge whatever concerning the daily functions performed by the different parts of their bodies, concerning the methods by which the circulation of the blood, the digestion of the food, or the locomotion of the body is effected.

How many of those who frequent ball-rooms and concert-halls could explain in the roughest way what really occurs, when sweet sounds of joyous music are propagated to the ear ? How many of us who live, so to speak, literally in an atmosphere of sound, could even most superficially form any mental representation of its numerous involved and varied features ? How many musicians have any notion as to what is the rationale of those complex trains and harmonies of sounds, which they are so concerned to produce ? How many have ever given such matters even a thought ? How many of us are content simply to receive impressions of external things, just as the lower animals do, without ever giving the slightest consideration to the causation of them !

Just as the curiosity of the savage is alike neither roused by artificial nor by natural wonders, so are nine tenths of the so-called educated, it would seem, unaware that there is aught of mystery in hearing and seeing, and ignorant that to a large extent these and similar phenomena can be explained. What happens when we see? What are those peculiar changes in the properties of matter which result in our consciousness of heat, of light, or of electricity? How many are there who ever think that there is anything worth knowing to be learnt about seeing or feeling, or tasting, or smelling, or thinking? How many possess the remotest conceptions respecting the manner in which the brain receives impressions, and transmits impulses in correspondence with them?

When we consider that a knowledge of such matters would affect and modify all our thoughts and all our actions, is it not strange that those who would be ashamed to be convicted of ignorance concerning some of the most unimportant and trivial affairs, are not at all impressed with any sense of shame at their want of acquaintance with the very barest scientific conceptions!

How powerless and impotent is the savage, who lives among the most wonderful perfection of grandeur around, to realise the marvellous perfections of Nature and the strange and wonderful mysteries everywhere apparent!

How little less powerless is even the educated man, who has never given his attention to the study of Nature, whereby he might understand in some small degree the wondrous world in which he lives!

Nay, more, how impotent does the man who really does know something of Nature's mysteries feel when, his imaginative faculties being highly aroused, it may be, by a moonlight walk through some grand scenery which rivets stern and deep attention by its marvellous beauty, he tries to realise how impossible it is for him to grasp thoroughly the workings of that wonderful and all-present energy of which he, the spectator, is perchance one of the humblest products? Yet his reflections, saddened as they must be by this consciousness of his limited sphere of thought and intelligence, are rendered brighter, when he remembers that each passing year adds to our stock of knowledge, and to our power over the forces of the universe. When he reflects, too, that, owing to his scientific training, thanks to the philosophic habit of mind thereby engendered, he can at any time, by concentrating all the powers of his intellect on some special branch, throw new light upon it, is he not thus

directly led to the firm conviction that it is far more important to bring out in the young that power of accurate observation which is so necessary for all good life, than to cram them with the results of bygone work, much of it misplaced, much of it comparatively worthless? It should not be our wish to produce men full to the brim of the trivialities of preceding generations; but we should aim to impart the power of advancing the capability of doing original work, and of carrying out researches into mysteries, now hidden and concealed from view.

People seem to be perfectly content with the idea that we do really know a great deal; but what is this to that which we might attain to? In fact so much remains to be known that we can never hope to appreciably diminish, far less to exhaust, our rich store. The new fields of inquiry open to us are so immense that it would be preferable, and far more profitable, to foster a spirit of inquiry, even in the uneducated, than to compel all to go through a long routine of hopeless, helpless drudgery. This is a point upon which too much stress cannot be laid.

When we reflect upon the immense waste of time annually spent on teaching the most profitless non-essentials, and the amount of misery thereby caused both to pupils and to teachers, it really is almost sufficient to make even those of us who are most philosophical sad and dubious of attaining good results.

That there can be schools in this nineteenth century of enlightenment in which science is not taught, and others in which it is taught most inefficiently, and in the most meaningless manner, institutions for training the young to become good women and men, in which the mere symbols of true knowledge are daily and laboriously pumped into aching brains, that this can still go on in the midst of progress all around on every side, and that there can be parents so deluded as to send their boys and girls to such schools, is a mystery indeed. That the chief and primary object of our lives, true good living, should thus be ignored and set aside is marvellous.

Mr. Herbert Spencer in his book on education, from which a few remarks here follow, well observes that, as in clothing, so also in teaching, the ornamental invariably precedes the useful. He points out the fact narrated by Captain Speke of his African attendants, who strutted about in their goat-skin mantles when the weather was fine, but when it was wet took them off, folded them up, and went about shivering in the rain.

And similarly, he continues, has that knowledge which conduces to personal well-being been postponed to that which ensures applause. He mentions that the majority of men are employed in the production, preparation, and distribution of commodities, and that efficiency in these matters depends upon the possession of adequate knowledge of their physical, chemical, and vital properties, *i.e.* on a due acquaintance with those principles and facts which come under the head of natural science. He points out that success in modern manufactures depends upon machinery, for the intelligent working and arrangement and making of which a knowledge of mechanics is needed. Under the head of physics we have to consider the immense advantages to be derived by a knowledge of the steam-engine, and the microscope and telescope, each of which last opens up to us an infinite field of wonders formerly unknown, the one in the direction of the minute, the other in that of the immense. The thermometer, the electric telegraph, the telephone, not to mention any of the innumerable other valuable physical instruments, must not be omitted in our general survey.

The applicability of chemical knowledge is extremely wide. The bleacher, the dyer, the calico-printer, the producer of metals, the sugar-refiner, the gas-maker, the soap-boiler, the gunpowder- and paint-manufacturers, each and all employ operations of a chemical nature. In short there is perhaps not a single manufacture to some part or parts of which some chemical knowledge is not indispensable, and we know how agricultural chemistry affects the farmer's pursuits. Again, out of astronomy has grown the art of navigation, while an acquaintance with geological observations greatly facilitates the utilisation of our material resources. Indeed, the iron and coal supply alone are of such primary importance to the prosperity of a nation, that but little need be brought forward in favour of a science which deals with them and similar matters.

Finally, biology claims attention. It is impossible to express the immense advantage of a knowledge of vital processes. Though at first sight, or to a superficial observer, it might appear that a study of such wide range, dealing at times with minute groups of organisms, whose conditions of vitality seem so absolutely distinct and remote from our own, is not of so much direct utility as are those sciences which deal with the constitution and properties of the various kinds of matter, and tell us how they may best be used for our own purposes, still it is manifest on mature deliberation, and after a closer inspection of the nature of the subject

and its relation to ourselves, that there is no other human knowledge which can approach this, in the magnitude of its importance and influence over our daily conduct.

It bears fundamentally on all processes of direct and of indirect self-preservation.

"With the all-essential manufacture, that of food, it is intimately and inseparably connected, and as the agriculturist must adapt his methods to the phenomena of animal and plant life, it follows that the rational basis of agriculture must always be the science which deals with such matters."

An acquaintance with the principles of physiology, one of the two divisions of biology, is essential to all good life.

"As vigorous health and its accompanying high spirits are larger elements of happiness [and of success] than any other things whatever, the teaching how to maintain them is a teaching which yields in moment to no other whatever."

"Such a course of physiology as is needful for the comprehension of its general truths and their bearings on daily conduct is an all-essential part of a rational education."

"But while men are anxious that their sons and their daughters should be well up in the superstitions of more than 2,000 years ago, they care not that they should be taught anything about the structure and the functions of their own bodies, nay even wish them not to be so taught."

"So overwhelming is the influence of established routine, so terribly in our education does the ornamental still override the useful."

Finally, the science of sociology is also to be mentioned as of the most vital importance.

"Every member of a community is deeply interested in understanding the laws according to which the commercial and other activities of the community vary."

We often hear much talk of people, especially of boys, being lazy, idle, and indifferent. There are, however, two sides to this picture; for, although it is undoubtedly a fact that such is true of many, we must not forget that they are to a large extent what others make them.

And again there are some to whom the temptation to excel, in spite of all obstacles, in spite of their own health being broken down by hard work, in spite of the ardent and fierce competition and rivalry to which they are subjected, is a thing in itself of no small moment and danger. There can be little doubt that many have been victims to such a fatal tendency, the strength of which a knowledge of science would do so much to diminish. There is still another aspect

of this question which claims our earnest and deep attention. It often happens that even those who are uncommonly lazy, may, by dint of earnest advice, encouragement, and stimulation of latent ambition, be induced to work with a will.

Moreover, there are some to whom, though ordinary studies and pursuits afford little interest, nevertheless special work in special directions, and especially in those having a scientific character, would be eminently adapted and suitable.

It is a fact that very many of the greatest men have confessed to the possession of feelings of idleness, and it is my firm conviction that very much of this seeming laziness is the result of lack of interest, of want of ambition, of ill-health, while being also partly attributable to thoroughly bad teaching and guidance.

Physical science is eminently calculated to call forth hidden talent, for many of the most practical have an abhorrence of mere words and cramming, whereas they delight in work which involves manipulative dexterity and skilful address.

If anyone should feel disposed to doubt this, let it be noted what enthusiasm is so repeatedly displayed, sometimes by even very young children, in the collection of curiosities, very often, it is true, of comparatively useless and worthless ones, such as stamps. Anyone who has observed the keen delight with which the young will attend while flowers, butterflies, beetles, or other natural objects are being collected, will not despise the incitements to the formation of accurate powers of observation afforded by such pursuits. Let it not be forgotten that this kind of enthusiastic ambition, if not another name for what we call genius and brilliancy, is at least one of the chief factors which aids, facilitates, and completes, the work of the talented. Indeed enthusiasm, carried even to the verge of fanaticism, has probably effected far more in the world's history than any other factor whatever.

Now that it has been attempted to show, not only that the place of physical science in education is in all respects an essential and very important one, but that scientific knowledge must even rather be considered as far exceeding in value all other acquisitions, let me in conclusion for a brief space discuss if we can ever hope to solve, by the aid of science, for without such help we certainly never could, those great mysteries of consciousness, of life, of that infinite and boundless energy all around throughout Nature's innermost ramifications so abundantly displayed.

Should it appear that there is even a possibility of our ever being able to do so, we shall find another and a still

more potent reason for insisting on the study of natural science in all schools and educational institutions, and this not by book-work, but by extensive practical application. We have exemplified to some slight extent the direct utility of it. Perchance we may be furnished with inducements for supposing its indirect utility may be, if possible, of still greater moment.

Underlying all our conceptions four grand data can always be distinguished—time, space, matter, and force. It is impossible for us to throw aside these ultimate ideas; and, though we cannot assign adequate reasons for our belief in their existence as realities, nay, even though we cannot adequately mentally represent any one of them, still there they remain, the inseparable and indispensable conditions of all thought.

Even those bitter controversies between the spiritualists and the materialists primarily rest upon the simple facts that, while the former lay the greatest stress upon the force, the energy, the life, the God, considered as a conscious and intelligent power, the latter are rather prone to place matter in the first place, giving less prominence to the idea of life.

Of these two views the former may be regarded as the more philosophic, inasmuch as we are only capable of regarding our consciousness as the representative in ourselves of that consciousness, far beyond it in power and extent, which we may be said to be justified in assuming, since, by no effort of the will, can we altogether elude the recognition of it.

Now, is it not possible that that integrating link which can generally be traced in all natural phenomena to a greater or less extent will, in the future, by the most able investigators and thinkers who are to succeed us, be capable of a still greater and more complete extension than we can as yet even imagine?

May it not be that, just as the mountains and the trees, and the varied shades of colour, heterogeneous and apparently distinct though they be, are wonderfully blended into one beautiful and marvellous combination, one splendid picture which strikes us as essentially single, and one alone, when portrayed on the retina, so in the future all our ideas of Nature may be linked into one harmonious image in the mind's eye?

Throughout the universe everywhere there is apparent this wonderful blending of the simple and the complex, of the exact, and of the involved and ill-defined. The highest results of scientific inquiry, by pointing out and making

clear more or less perfectly this oneness, do but establish those simple and intelligible views of Nature which we can hold, even in regard to its most complex aspects. Thus does knowledge, as it becomes wider and more complete, also gain in simplicity. When we have obtained the right point of view, half the battle is gained, and the victory is half won. As they grow and become more diverse and more complex, difficult matters at the same time become more simple, and lose their stumbling-blocks and obstacles.

Gross and exact symmetry was once the highest ideal of beauty, and this was because that more involved symmetry which underlies apparent asymmetry was then not seen. The wider grasp of beauty, this more complete conception of Nature's symmetry, at first obscured in men's minds by that asymmetry which is to a superficial observer more apparent, is an instance of the wider perception of unity and of one power, which has been growing throughout the past, and is likely to grow much more.

From the abstract let us turn to a concrete example. Who at first sight would claim beauty for human skulls? Yet, after careful study and painstaking investigation of their conformation, do we not see the most marvellous beauty in the accurate adaptation of means to ends, even in these poor relics?

Let us cast away all poetic ideas of past associations; we will not think that the owners in bygone days had hopes, and fears, and anxieties, and anticipations of woe and misery, or of joy and gladness; we will not surmise that they were perchance the heroes of mad onslaughts, of rash precipitation and savage fury; we will not say they fell victims to their bold desire for right, nor sing of the love-scenes they aided so lovingly to enact. All that we will claim for them is that by their means we can understand many matters, otherwise difficult to comprehend, that by the study of them the surgeon and the physician and the dentist are enabled to extricate us from many of those diverse ills to which we are heirs, and that we can from them infer the truth of the vertebrate theory of the skull, one of those grand generalisations which supports that still wider idea of unity of type so abundantly illustrated throughout the two kingdoms of living organisms. To the investigator, then, even a skull is a thing of beauty and a joy for ever. And if they serve also to remind us forcibly that we, too, are mortal, who will gainsay their value, even while refusing to admit their beauty?

At least all will agree that beauty can now be discerned

where formerly it was not apparent. And as we look into the not far-distant future, can we not discern still more perfect ideas of Nature's ever-perfect charms, when we may perceive the asymmetry with the symmetry which commands it, still more completely and intimately blended and combined? Such a picture, surely, the imagination may paint, dimly looming afar off, it may be, but daily becoming more distinct and more near. The marvellous rhythm of Nature will then be seen to be far more perfect than is now imagined; the interminable chain of causes and effects will be clearly discerned, never beginning, never ending, but gradually balancing one another to produce systems more and yet still more stable and perfect and whole. Then will our boundaries, our limitations, the landmarks of our feeble powers, break down to be replaced by wonders we know not of.

"But amid the mysteries which become the more mysterious the more they are thought about, there will remain one absolute certainty, that we are ever in the presence of an infinite and eternal energy from which all things proceed."—SPENCER.

Furthermore, notwithstanding that there is always to be detected "a soul of truth in things erroneous," it is none the less certain, that the current beliefs of men should be as rigorously tested, as the conduct therewith associated is to be most critically examined. It seems strange, indeed, that though the experience of generations would surely have gone to show that each man succeeds in the world, *cæteris paribus*, in exact proportion to the merits of his actions, and that he who brings about the greatest good to the greatest number of his fellow-creatures is, as a rule, the most highly esteemed, still the statement is very frequently made that this individual, or that individual, has been enabled to climb upwards by some *lucky chance*; and that another has, by dint of sole attention to his own selfish interests, achieved great ends.

It is no doubt true that in exceptional cases rewards are out of proportion to deserts, but regarded from a general standpoint, such assertions upon examination prove to be not only unfounded, but even self-destructive. However discredited by direct evidence, misapprehensions of this nature (such is the extraordinary perversity of the mind) survive, even in the most highly cultured among us, to a very large extent; and it scarcely seems too much to say that one at least of the primary objects of education should be to instil into the minds of students that, throwing aside for the sake of argument the consideration of other factors

such as what may be called the initial capital, viz. the general state of body and mind and worldly possessions which each one inherits, it is literally and emphatically an indisputable fact that the modelling of one's future is to a large extent within one's own power. This, it is true, is a conclusion which most of us accept in some sense; but men differ largely in the extent to which it forms a basis of their daily conduct.

To show, in fact, that throughout Nature action and reaction are equal and opposite; to prove to the young that it is far more important and more true to believe that "one should control circumstances" than that "circumstances make the man;" to demonstrate how, throughout our whole life, we should bear this in mind and act up to it;—to do this,—our best efforts should be directed, and we should strive to the utmost of our power to carry it out, not merely superficially, but in the most extended sense.

Of the general objects of training, it is perhaps of greatest importance to point out the way in which every action, whether internal or external, affects the welfare of the organism.

With regard to the more special aspect of the subject it is almost unnecessary to lay stress on the fact that, speaking generally, to produce a very well-educated man or woman is neither a difficult nor a long task.

In considering education it is necessary to draw this distinction between special and general teaching. A certain amount of special teaching is of course absolutely necessary. The most stringent accuracy of observation and of logical thought, cannot be too much insisted upon; but it is a mistake to think that the actually necessary learning which requires to be taught is large in amount. We have only to recall to our recollection how, on the one hand, many very imperfectly educated people have startled us with their successful career, and, on the other, how many of the highly trained fail, to appreciate that, after all, the actual amount of knowledge indispensable for success is not large nor difficult of attainment. Physical science is of value, then, for many reasons, not only because the knowledge of it leads to a wider and wider recognition of the universal law of causation; but also because each minute portion of it may be a means to the direct material advancement and prosperity of mankind.

Of all the departments of natural science, the one which is of highest value is that knowledge of the phenomena of life which is designated biology. In the teaching of this science some of the principles of sociology and psychology

might fitly be included; but, interpreting the term in the more restricted sense, what can be of more transcendent interest to all of us than to clearly understand the conditions which subserve healthy active living?

While saying that biology, the science of life, should be taught in every educational institution, to a greater or less extent, as might in each case, and under varying conditions, be found possible, we do not hold that students should be crammed full of the interminable details with which every division of this all-important subject so largely abounds.

On the contrary, it would be our wish rather to advocate a considerable lessening of the amount of dry facts, with which every schoolboy and every schoolgirl is now expected to be familiar. It is rather general principles which should be inculcated, while to the specialist should be reserved complex research.

Our desire should be to teach how to learn. Initiators rather than imitators always receive the prizes in life. Why, then, are educational regulations so often framed with no result apparently in view than the production of imitators?

It is deeply to be regretted and deplored that not only is *the* subject of all others most conducive to right living scarcely taught; but that many teachers, devoid as they are of any real knowledge of the subject, too often display their ignorance of it by utter disregard of the most elementary requirements of health.

One hears and reads heartrending accounts of the over-pressure which is rampant in England and Germany and France, in fact in nearly all countries.

Now, herein we see how education depends on natural science, inasmuch as such mistakes as this would certainly have been obviated, had those who are now in positions of authority been properly educated.

The results of education, literary as well as scientific, like all other facts in the world, are to be estimated purely and simply by scientific standards; and it seems scarcely necessary to mention in conclusion overcrowding, bad ventilation, too close proximity of class-rooms to sources of contamination, lack of exercise, excess of amount of work expected to be done, whether under supervision or at home, the imposition of heavy tasks immediately after meals, and badly arranged dormitories—to show how educational regulations are not always based upon scientific knowledge.

Had space permitted, we should have endeavoured to discuss how intimately the science of life is connected with the other sciences, and also how the study of other subjects,

such as chemistry, should always include principles and facts which bear upon the one important end and aim of all,—“good living;” but we must now conclude this chapter.

Is it possible to conceive that man can more profitably spend his brief time on earth than by investigating and making known that wonderful energy of which he himself is possibly one of the highest products, one of the most perfect expressions? During the short period while we are here, in this fleeting world, how can we work more wisely than by looking, with as much power as is given to us, on Nature's and on God's eternal power, and searching into the mode of working of His great laws? The possibilities, nay, even the probabilities of the knowledge which lie before us are immense. By diligent and enthusiastic work such knowledge can be found. Let us try to inspire this enthusiasm in our fellow-men. Let us show them which are the most profitable, the most necessary fields of work.

As we wander up a mountain's rugged side on a cool, bright freshening day the sun shines less dimly; slowly gathering power o'er the mist left by the rain, and the rippling rills, gurgling while they wend their way o'er stones and flowers slowly downwards to the plain below, make the calm silence break with notes of varied kinds, which blend with songs of birds and the hums of busy flies. Gazing at the rocky crags, each in its place, we muse in solitude solemn and sweet: and the rich beauties of the wondrous scene, with the sounds of merry joy and life, wake up and light the sense that all around each sound and stone and bird and flower has fitly found, or straightway fitly finds, its rightful place.

A few more sands of time must fall, before men will know what it is best to learn and teach, and then the charms of Nature will never clash with the thoughts and words of the mighty of the earth, but all will blend together like those grand harmonies which we—alas! how vainly!—strive to realise, when riding light-heartedly through beautiful rural scenes on a sunny summer's morning.

CHAPTER IX.

The Evolution Hypothesis regarded as the Fundamental Assumption of the Science of Ethics.

It is when we consider what are the rules of right conduct, that we begin most clearly to appreciate the great value and primary importance of that theory, which underlies at once all conceptions of natural processes, and all principles of good living.

To every thinking man, woman, and child, a grave question seriously presents itself, as a problem for solution. Is it or is it not the case, that we can offer some rational and acceptable hypothesis, as a provisional explanation, of the working of all natural phenomena? Shall we consider that life and the universe constitute one meaningless gigantic farce: or are they not rather to be looked upon as exhibiting a regular, systematic and progressive advance?

It is indubitable that some idea of a Great First Cause is indispensable as an adjunct to—indeed it may be said as a condition of—orderly thought; but when this has been admitted, there is a question of paramount importance, which still arises.

Are we to suppose that this First Cause, this Supreme Power, has given origin to an irregular system, a series of disconnected irregularities, which proceed in the absence of order, and arrangement, and unity; or are we not rather to conclude that the method of procedure followed, in the case of natural phenomena, is one and uniform, direct, definite, and invariable? Can we not trace in the relation between our actions and their results, as between all pre-existing and succeeding phenomena, the reign and working, of an inexorable and inevitable law?

If we can thus observe a definite connection, and, other things equal, a practically unvarying sequence; then it follows that our science of ethics must be one which recognises such law, and makes it its primary and fundamental basis. The theory of evolution, which is nothing less than a universal law of causation, or as it might be called the doctrine of consequences, is not yet sufficiently acknowledged in relation to questions of what is right and what is wrong in conduct.

We shall find, however, that just as the hypothesis itself is the grandest and most important generalisation of which we are capable of forming a conception; so the application of it as a guide to daily conduct, is undoubtedly one of the surest and truest conditions of success. Were we all thoroughly and unmistakably convinced that every single act, no matter how small and trivial it may be, is directly and immediately connected with certain consequences, which continue to produce in their turn, similarly connected resulting effects; how much more careful should we be in the everyday affairs of our busy, active lives, in each thought, word, and deed! For though it may be argued that the amount of volition possessed by each individual is not very large, much less unlimited; still it is indubitable, that wonderful and marvellous results can be obtained, by the man or woman, who has thoroughly learnt the severe lesson of self-restraint—the most arduous, the most enduring, and the most difficult of all lessons. The attempt to keep a strict guard over our actions, is one which we ought always to practise, and to enjoin. Men, however, will not be sufficiently impressed with the essential nature of such self-compulsion, and with the importance of postponing, or altogether denying themselves small gratifications, unless they completely recognise, that every right or wrong act, will inevitably bring its corresponding results. Nevertheless, while it is true that every ethical system takes for its aim, a desirable state of feeling in self, or others or both, here or hereafter;—and it is impossible to conceive any basis of inquiry into the conditions of right conduct, not herein included;—still it is observable that, irrespective of their distinctive characters, nearly all the current methods of ethics have one general and gross defect, inasmuch as they neglect, or very inadequately recognise, ultimate causal connections. The natural and direct consequences of actions, if not almost entirely ignored, are at any rate often only incidentally contemplated. Hence the most important of the ultimate purposes of philosophical investigation is to find and to formulate for the principles of right and wrong in conduct at large a definite scientific basis.

The explanation of the direct and indirect consequences of actions; the statement of rules of good living, founded on the observed connections betwixt vital processes and bodily welfare; the extension, in short, of the line of thought, so ably indicated by Mr. Spencer in his *System of Philosophy* generally, and in his '*Data of Ethics*' in particular; to aid in bringing his conclusions before the notice of mankind;

to do this, is in these times a pressing need, an essential and necessary work, not admitting of postponement. If the best way of explaining natural phenomena and existences is to suppose that they have arisen as the direct results of pre-existing phenomena and existences, is it not of paramount importance for us to use the volition we possess, in the manner and direction clearly indicated, by the almost absolute certainty of the continuance, for a practically unlimited period, of such causation?

The conduct with which ethics deals is not the aggregate of all the actions of mankind. It is part of that whole, and in order to comprehend it, we must strive clearly to understand conduct at large, and the mode in which all vital processes have been gradually evolved from the activities of lower living things. Whether we look upon ethics from the physical, or the biological, or the psychological, or the sociological, aspect, we shall see that the evolution hypothesis is the fundamental assumption which underlies all valid arguments respecting it.

The physical conditions of conduct are seen in the fact that those complex combinations of motions which organisms display, must conform to the law of the persistence of energy, and must exemplify those redistributions of matter and motion which make up evolution.

Secondly, looking at the biological side of the question, when we consider the vital processes exhibited by the lowest organisms, and by successively higher groups, we shall find explanations, some of them most curious and interesting, of many ordinary human actions. The activities of lowly-developed creatures are explicable to a very large extent as occurring in accordance with purely mechanical principles, as relative to, and caused by, changing factors in the environment. The admission that there may be conditions affecting all kinds of living things, of which as yet we know nothing, clearly does not vitiate our carefully-considered relative explanations.

When we proceed to the successive consideration of more and more highly-developed organisms, we find that the vital activities, including those various and complicated ones which make up volition, become more and more complex, more and more deeply involved, more and more strongly marked, so that the relation between internal and external processes, still doubtless an exact one, becomes increasingly difficult to trace.

Thus we find, when looking upon the higher animals as having been gradually evolved, in harmony with the law

of causation, that the activities they display can be largely comprehended in their genesis, though the comprehension is by no means easy.

Again, ethics has a psychological aspect.

"Symbolising by *a* and *b*, related phenomena in the environment, which in some way concern the welfare of the organism; and symbolizing by *c* and *d*, the impressions, simple or compound, which the organism receives from the one, and the motions, single or combined, by which its acts are adapted to meet the other; we saw that psychology in general is concerned with the connection between the relation *a b* and the relation *c d*. Further, we saw that by implication the psychological aspect of Ethics is that aspect under which the adjustment of *c d* to *a b* appears, not as an intellectual co-ordination simply, but as a co-ordination in which pleasures and pains are alike factors and results."* We should find that such adjustments of internal to external relations have become more and more complex as we ascend the scale of life from the lower to the higher animals.

Let us now take a very brief glance at the sociological aspect. This will lead to a short discussion of the relation of the principle of Egoism, which may roughly be spoken of as practically equivalent to selfishness—though bad motives are not necessarily implied in the term—to that of Altruism, which may be said to consist in the withdrawal of the claims of self, and the extension of positive benefits, prompted by sympathy and generosity, to our fellow-men. It will then be indicated that pleasures and pains will in all probability be largely modified in that future state to which we are gradually progressing, and that thus an increasing preponderance of genuine Altruism will be brought about.

Aided by the light shed by this idea of continued progress, we might profitably consider what characters an ideal man in a perfect social state would display. If we could imagine correctly such a condition, if we could determine what kind of state the highest might be, we should be able to understand what is right and what is wrong, in conduct as displayed under existing conditions. We should conclude that conduct will gain sanction in proportion as it becomes less and less aggressive, and more and more industrial in character.

Human actions will become good and right in every sense when they do not necessitate mutual injury, but

* The 'Data of Ethics,' by Herbert Spencer, third edition, page 129.

rather imply extensive co-operation, extensive exchange of benefits, and extensive mutual aid beyond fixed agreement.

We find on discussing evolution that its chief feature is the production of larger and larger aggregates, with parts more and more intimately connected, though the parts themselves have become modified to a marvellous extent. In other words, an increasing amount of integration of diverse constituents is the characteristic feature of the highest aggregates of whatever kind. Indeed, the highest organisms may be considered—as is proved to be the case by microscopic analysis—to be but aggregations of structures (cells) which simulate closely the lowest creatures.

These have been modified and connected in ways and degrees which seem nothing less than miraculous. The colourless corpuscles of vertebrate blood, for example those of man, may be mentioned as being to all intents and purposes distinct animals, with independent life, simply carrying on their vital processes in a liquid menstruum.

Now, as an animal or plant is composed of largely modified cells, so is a society to be looked upon as an organic whole, whose constituents are the members composing it.

Hence, though the welfare of the society is compounded of, and dependent on, the maintenance of the well-being of all its members, still the prosperity of each individual is to be looked upon as to some extent distinct from that of others. As the society progresses, the integration, the knitting together of the social units, will become more complete, and the general happiness will be still more directly dependent on that of individuals. In the present state of social conditions, however, that 'self-preservation is the first law of nature,' is a maxim which cannot be altogether laid aside. But we must remember that the law refers with still greater and more emphatic truth to the society or nation, considered as an independent aggregate, or whole, than it does to each separate individual, who, like any single cell of a multicellular organism, helps to carry out the grand struggle for life, to which the society, the larger aggregate, regarded as competing with other groups of individuals, is in a much greater degree exposed.

An important corollary must therefore be added to the aphorism quoted above; for it is an indisputable truth that 'the individual who brings about the greatest good to the greatest number of his fellow-men, deserves, and generally in the long run secures, the greatest rewards, the greatest good in every sense.'

Thus we have indicated the two classes into which

human actions have been divided,—the egoistic, and the altruistic.

Of course it may be objected that after all it is simply a question of relations, requiring an almost impossible definition of terms; for the principle of Altruism as currently conceived may be pursued from egoistic motives; but still there must be drawn a distinct line of demarcation between the Egoism as ordinarily understood, and that greatly modified form of it which includes the widest altruistic acts.

It is possible that after consideration we might in certain cases be able to ignore the distinction, or rather combine the two ideas, by some kind of compromise; but let us firstly note how the carrying out of egoistic or of altruistic activities, as generally comprehended, might affect the welfare of the individual, and that of the society.

We can scarcely refrain from admitting that the care of the individual for self must precede acts in favour of others in importance; since the activities which are absolutely necessary for the maintenance of life, must of course nearly always be more peremptory than all other acts. The man who carefully preserves a sound mind in a healthy body, gives origin to offspring endowed with good constitutions, is by virtue of his good spirits a source of pleasure to all around, and retains his power of conferring benefits on others. On the contrary, the self-abnegation in excess which would be a necessary concomitant of undue Altruism, must involve not only the inability to aid others, but also ultimately the infliction of actual burdens on kindred and fellow-men, and at the same time it would prompt extreme Egoism on the part of those who have been so greatly benefited. Indeed, Altruism may be carried to such an extent as to amount even to self-destruction.

We may see, however, that from the dawn of life Egoism and Altruism have been becoming more and more interdependent.

The self-sacrifices involved in the production and rearing of offspring exhibit Altruism in its primitive form; and gradually parental and family solicitude pass into social or general good-feeling. That this general Altruism is a most important factor in the maintenance and well-being of a community scarcely requires illustration; for, clearly, the welfare of each is involved in that of all. The more vigorous a community is, the more productive it becomes, and the cost of everything diminishes in proportion. The healthier the society is, the less liable is each member to the attacks

of disease. Whatever raises the intelligence and moral character of all must bring great benefits to each individual.

This dependence, however, of the welfare of each on that of all is one which is continually ignored, and it leads to the grossest forms of Egoism. The general opinion of men is often rather that they are likely to receive benefits from disasters inflicted on others, and in consequence they attempt to climb upwards by first pulling others down. Such narrow Egoism is most deplorably wrong and self-destructive. Again, by estranging those around him, the selfish man loses the incidental aid which they can render him, shuts out a wide range of real pleasure in the shape of social enjoyments, is debarred from participation in some of the greatest, truest, and best of human joys.

This dependence of individual happiness on the actions and feelings called sympathetic, not only applies within the limits of each society or nation, but also to mankind at large. It is not only the well-being of the particular society, of which one is a member, but that of all other societies to some extent, if to a less extent, which concerns primarily each society, and secondarily each individual.

Within each society, as it advances, mutual dependence of the members increases; and it is also clear that, as the dependence of societies on each other similarly progresses, in virtue of increasing commercial intercourse, the internal welfare of each becomes a matter of concern to all. The impoverishment of any country, diminishing both its producing and consuming powers, must tell detrimentally on the peoples of countries trading with it. We have had abundant experience of industrial derangements brought on nations, not directly concerned, by the carrying on of wars between other nations. A great war entails a serious loss not only on the struggling peoples, but also on the whole civilized world. This fact is often lost sight of.

Is it possible that a good compromise may be ultimately established between activities which are directly self-sustaining, and those classed as sympathetic or altruistic; so that we shall no longer be in doubt, in the majority of cases, as to what is the best course to adopt?

Nothing can be more difficult than this. We are yet very far from having the requisite knowledge. There are, however, reasons for believing that we are now much nearer than we were in the past to a clear appreciation of what is right and what is wrong, what legitimate and justifiable, and what illegitimate. We are now gradually arriving at some idea of a resultant, a balance, a compromise between two extremes.

This is showing itself in the present customs and usages of mankind, when compared with the horrors of the past.

We can trace in late history a tendency towards the doing away with all oppression, and we find that each one can now, far more readily than in the past, have all that is justly due to him; while at the same time it is observable that voluntary efforts on behalf of others are increasing hand in hand with the securing of individual rights and freedom.

This holds good also of the relations between societies, as is seen, for instance, in the greater respect paid to treaty obligations, and in the diminishing amount of aggression by nations on one another.

The interesting question suggests itself, "Will wars ever cease?" "Will there ever be no unjust aggressions?" "Would it be well for the human race if we could answer unreservedly, *Yes*?"

Whether we can or cannot, however, at any rate we shall find it most desirable to postulate the probability of an ideal social state, to be reached in the future; and we must now consider what the relation of egoistic to altruistic activities will be, under these perfect social conditions, to which we are presumably by slow degrees advancing. If it is not admitted that the human race is progressing to a better state, it is exceedingly difficult to prove that animate existence is very desirable. At any rate a very strong case can be made out by the pessimists, unless men are improving.

While it is perhaps even now to be inferred that, on the average, life brings more pleasure than pain to human beings, there can be no doubt that, if we look forward to a far better and more perfect state of society before us at which we must strenuously aim, then life is not only desirable but a great boon, and brings a weighty and most responsible duty.

The best deeds are those which bring about the greatest good to all, which secure the happiness and prosperity of the largest number of fellow-men, which make possible the greatest totality of pleasurable life in self, offspring, and others.

Now, how can this wished-for consummation be aided? Neither direct nor indirect aggressions on the character, person, or property of others are consistent with a good social system. Men must also voluntarily help and aid one another.

Unfortunately this extension of benefits to others can seldom be effected without in some degree immediately damaging personal welfare. In many cases, however, the

benefits which will in turn accrue to the benefactor are conspicuously seen beforehand.

Thus it is true that now when men help one another, it is often as a result of self-compulsion, which in its turn is attributable to a regard for future rewards.

This is not at all what ought to be, and it fails in two points.

Firstly, self-interest ought to be entirely out of the question, completely lost sight of; and secondly, good deeds should be done without effort.

They should be spontaneous, and done not for the sake of reward, but from a regard for duty, for right, for what is best for mankind at large. The individuality should be almost forgotten, and only remembered and cared for so far as the present and future necessities of life enjoin.

Let it be remembered that he who seeks self-gratification consciously, generally fails in finding it, while those who do good for duty's sake, have, in reality, a larger proportion of true and enduring happiness.

The injunction to sell one's goods and give to the poor, and follow Christ, though such extensive almsgiving is scarcely to be recommended nowadays, was, doubtless, under the particular circumstances, the best possible advice, and it most certainly points to the *kind* of conduct which men should look to for their ideal.

We find reasons for supposing that in the future not only will human actions become better, but also that they will at the same time become more easy, more natural, and more normal.

If we consider successive stages of conduct we find that, firstly, correct actions are enforced by others, by authority; and that, secondly, as the intelligence rises, and as a more clear perception of the consequences of actions is gained, the compulsion from without is replaced by self-compulsion. Further, we may infer that similarly this self-compulsion must at a still higher stage also practically disappear.

In the successive stages of life we find written, as in a book, the incontestable truth that pleasures have increasingly become the concomitants of normal amounts of functions; while pains show themselves more distinctly characteristic of excesses and defects of functions.

If we consider the normal processes of a healthy animal, such as a man, we shall find that there is not one single function that he performs which is not joyfully performed. A perfectly healthy animal may be said to be in a constant state of enjoyment.

In the case of the highest animal, man, new pleasures, new functions, have been taken on, which have revolutionised his habits. Except in the case of primary vital necessities, he has been subjected to a change of conditions, unusually great and involved, and these immense changes have considerably deranged the guidance which pleasures and pains normally afford. Hence it happens that even the most highly endowed cannot act altogether under the supposition that their own impulses, desires, and aversions, are sure and trusty indications of what is right and what is wrong.

In the future, however, we may expect that not only will our bodily pains and pleasures be more reliable tests of bad and good, but that the higher sentiments, too, will be exactly suited and proportioned to what is best.

The requirements of social life will eventually make all needful activities pleasurable. We have only to think of what has already been effected in the way of adaptation to strangely changed conditions, to perceive that the possible amount of modification is practically almost infinite. The activities in which the savage delights are no longer a source of pleasure to the majority of the civilised, while at the same time the latter have acquired the capacity of finding great gratification in actions which are entirely novel, and at first were very arduous and strange.

From continual repetition an activity which at first is quite distasteful may become pleasurable either to ourselves or to offspring. There are in short no activities which may not become sources of happiness, provided the surrounding conditions require persistence in them.

Now, the actions prompted by fellow-feeling are among those demanded by social conditions, and eventually sympathetic joys will be pursued to the fullest extent, which is advantageous to each and all, and not from egoistic motives.

In the truly sympathetic, the attention is so absorbed with striving for the happiness of others that the prospective self-happiness which may result is quite lost sight of. The altruistic pleasures, though in one sense necessarily egoistic, are not consciously so.

Nevertheless, it is to be remarked that the postponement of self to others, which constitutes Altruism, as ordinarily conceived, must in several ways become more and more limited as the highest state is approached. Inasmuch as extensive demands on the benevolent presuppose much unhappiness, the existence of many in a state of comparative misery and wretchedness; these demands must become

less and less, as we all advance to a higher state. Though it is true that, as the conditions of life are at present constituted, the increasing survival of the fittest apparently means increasing degradation of the unfit, we must remember that as evolution advances there will be less and less of the unfit.

Moreover, with the progress of adaptation, each will become so constituted that he cannot be helped without the arrest of a pleasurable mode of activity, and therefore as men approach complete adjustment of their natures to social needs, there must be fewer and smaller opportunities for giving aid. Again, while each, when occasion offers, is ready and even anxious to withdraw his own claims, others similarly constituted cannot but resist the surrender. The Altruism of others must restrain individual excesses of self-abnegation, and a true and genuine sympathy for fellow-men, cannot but become increasingly general.

It may be said that as all become better, a normal kind of altruistic Egoism, or of egoistic Altruism, will be produced, but it will be more sympathetic than selfish. In it will be seen the resultant of the two kinds of claims, viz. those of the individual *versus* the rights of the society on the one hand, and the reverse claims of the society on the other.

Excessive Altruism will partly be prevented by the fact that self-abnegations which are unwarranted imply on the part of the actor an ascription of selfishness to those who are to be benefited, and partly because each person will be debarred from undue pursuit of altruistic pleasures, by the certainty that others also desire them. Excessive Altruism would under such conditions in reality constitute Egoism.

In its ultimate form Altruism will largely consist in the gratifications and pleasures to be derived from sympathetic participation in the joys of others. There will always be three spheres for altruistic actions, viz. that afforded by family life, that offered by mankind at large under ordinary conditions, and that produced by misfortunes and disasters, flood, fire, plagues, shipwreck.

There will always be good to be done in the warding off of unknown evils and dangers from one's fellows.

The hope of securing the pleasures of others is now a mark of those human beings who are exceptionally high and noble; but that which the best are capable of is within the reach of all future men and women.

We see, then, reasons for presuming, that in the future

that apparent conflict betwixt self-regarding impulses and altruistic motives, which now seems so marked, will practically disappear.

If we could ascertain the best laws of right and wrong, not in societies as at present existing, but in ideally perfect societies, we should be able to ascertain how actions, as carried on under present conditions, deviate from the right, and how the good and best can be most nearly approached.

By the formulation of rules of conduct in an ideal society, we should reach a science of absolute ethics, which, when used to interpret the phenomena of real societies, in their transitional states, full of all the miseries due to non-adaptation, would enable us to form approximately true conclusions respecting the natures and causes of the abnormalities, and thus to ascertain the courses of action which would tend most surely in the direction of the normal. The ideal man and the ideal social state presuppose one another, and only when they coexist can there arise that conduct which absolute ethics has to formulate, and which relative ethics has to take, as the standard by which to estimate divergences from right and degrees of wrong.

Of all human conceptions in the present and in the past, the greatest, the widest, the most powerful is that of the doctrine or theory of consequences, that of causation, that of evolution. The most complete expression of the idea that every cause has its effect, and that no effect can be produced without a cause, is the evolution hypothesis, the law of universal causation, so ably expounded by Mr. Herbert Spencer, in his system of philosophy.

If we fully recognise that all things as they exist to-day, as we see them, have been gradually and slowly but surely produced, according to an unvarying law, we shall by applying the corollary, which is an obvious one, to our daily conduct, be able to carry out our life's plans, our daily work, in a manner certain to produce the best possible results.

If we thoroughly believed that each act we commit, whether word, or deed, or thought, produces a definite, certain and unerring effect, which will eventually and inexorably react not only on ourselves but on others, what care and pains should we take that each deed, each word, and thought should be duly weighed! Bearing in mind that a thing done can never be undone, that its effects are continuous and inevitable, let us all strive to benefit not only ourselves, but the whole human race, present and to come. A higher degree of happiness will hence result to all.

Now we see the prosperity of the few, and the misery of the many. This will not always be. There must for a long time, it is true, be great misery, wretchedness, and poverty, but such unfortunate concomitants of progress will gradually become less and less necessary.

We must, however, in the meantime, refrain from arbitrary and ill-advised attempts quickly and forcibly to prevent misfortune.

The process of elimination of the undeserving must and will go on, and indiscriminate aid to deserving and worthless alike will inevitably fail; nay, will produce the more suffering.

We must strive to foster in the weak and immoral—and all kinds of immorality, of crime, and of intemperance are really due to lack of strong intelligence—the power and spirit of self-help, and not the habit of reliance on others.

We can do much, by thus teaching, to lessen human misery. Let us be careful how we carry out reforms which, though apparently for the time being essential, may not ultimately further this end. Let us beware lest, striving to lead too quickly, we stumble by the way.

It is true that by the law of progress the superior profit by their superiority, while the inferior lose in virtue of their weakness.

When will the superior adequately recognise that they give best proof of their superiority, by trying to aid others, all their struggling, striving fellow-men? When will men learn that they who put away all selfishness, all jealousy, all narrowness, and walk on firmly and erect, paying out rather mercy than hard justice, are those who in their unstinted, large-hearted generosity, have found the indispensable condition, the sure clue to progress and success?

All other things shall be added unto them.

What is there in life so well worth living for as the good of others, and the pleasures of sympathy?

CHAPTER X.

*Rational Politics.**

THE study of the many branches of physical science clearly shows us, that the world on which we live, and move and have our being, and that the universe, of which our world is but a tiny portion, are governed by laws, fixed and immutable. If we look back into the dim old ages long gone by, before men had learned the art of writing records of their deeds and surrounding, and if we strive, as well as our knowledge of science will enable us, to trace the histories of our remote ancestors, we shall learn that these natural laws have always acted uniformly, constantly, and with a very definite result. Their combined effect has led to the gradual evolution and establishment of a higher, a nobler and more differentiated human being than the primitive savage, whose only weapons consisted in unpolished stones or other materials shapen to suit his wants.

Progress, however, though uniform, is, and always has been, accompanied by retrograde steps. Great nations have fallen in the past, never to rise again. Many have left behind them but the barest traces of their former existence. Their histories have been well-nigh obliterated by the gnawing edge of fleeting time. They have fulfilled their mission. Their day is past and gone. It may be they disobeyed the laws of health, or the laws of morality and honour, or perhaps they abused the power they had gained. To such disobedience nations have owed their decline and fall. Very few, in short, are the nations of the past whose disastrous ruin has not been traceable to excess of some kind or other.

Periods of true progress, it is evident, have at all times been interrupted by periods of temporary retrogression. This is the inevitable course of nature. But we need not weep for the past, or regret that the earth changes, for "did it keep a stable changeless course 'twere cause to weep," nor need we lend our support to thwart the onward progress of our noble nation.

Fixed and immutable, never changing, never ending, per-

* This chapter is almost entirely taken, most of it in fact word for word, from a pamphlet of the same title, written by the author's brother, Mr. Charles Gresswell, M.R.C.V.S., of Nottingham (Nottingham: Thos. Forman and Sons, 1885).

fect and inviolable, these natural laws are the expressions of the will of Him who framed them. We have learnt much about them, but we have still much to learn. We have learnt much of them in the field of chemistry and physics, and our minds are now awakening more than ever before to their influence in biological and pathological science. It is remarkable, but it is not to be wondered at perhaps, that it is when we seek to fathom them in the regions of social and political science, we find so much disagreement, resulting in bitterness, jealousy, and misunderstanding. We may pause to ask why men are not agreed as to the best methods to be adopted in order to regulate the social laws which govern us. The reason is not far to seek. It is not that these laws are in this field vague and uncertain, not that they are imperfect, unfixed, or changeable, but because men do not yet know them, because the innumerable number of its professors have not as yet realised that sociology is a true science.

When the full radiance of truth has beamed upon us, and we are able to realise not only the continuity but the justice of the natural laws, we are confronted by still greater mysteries. We allude to the marvellous co-ordination of the laws governing all natural phenomena. No law of nature is isolated. In no instance does one set act independently of the other. All hinge upon, and are dependent on, one another. It will be readily understood how impossible it is to gain a thorough insight into the laws regulating social customs, without a previous knowledge of the more obvious sciences.

Closely connected with the sciences of chemistry and physics is the science of biology, with its multiform subdivisions. A knowledge of psychology and the study of life in its many forms teaches us how to attain to the highest degree of perfection. Social science is as yet in its infancy. Still, although very imperfectly understood by the multitude, it is nevertheless of primary importance. Ever has a true knowledge of its laws been dimmed, as were the other sciences but a short time ago, by the grossest errors based on superstition and ignorance. Their passions, egotism, and ignorance, have at times caused men imperfectly educated in the science to become leaders, and their followers to be constantly veering between worship and contempt of their chiefs.

In no age has science made such rapid strides as in our day. Our stock of knowledge is advancing at a speed before unequalled in the history of the world. Only recently have men given their close attention to the facts bearing on the gradual development of the civilised human

being from the primitive savage of past ages. Only recently has man endeavoured to trace all religions to their primitive source. Only recently have we realised that truth pervades each one of the many forms of trust in the Deity who guides and rules the universe.

We may discern in all the laws of nature one grand principle which can scarcely fail to attract our attention. The principle to which we allude is the accomplishment of the progressive advancement of the multitude through the agency of the individual units. One cannot too firmly grasp the endurance of this great principle. It can be discerned in every one of those sciences, the aggregate of which make up the one grand science of biology. By bearing in mind this principle, each one of us will be able, even if ignorant of many facts of the science of life, to judge which group or division of the present professors of social or political science are most to be relied upon, which group base their actions on a true knowledge of the laws of nature.

Let us pause again awhile to consider the condition of man in his early crude state of savagery in past times. With him might was right. His life depended upon the power he possessed over the lower animals, in virtue of his reasoning faculties. The tribe of which he was a unit owed its preservation to the possession of strength sufficient to grapple with neighbouring antagonists. Further progress took place proportionately as man settled in salubrious places where food was abundant, and was, by the accumulation of strength, sheltered from the attacks of nomad tribes. When the chiefs of these early historical times gained some knowledge of right and wrong, and gave not way to wanton cruelty, but exercised the faculty of self-restraint, man first began to make definite steps towards advancement. In the struggle for existence, then as now, the strong survived. That tribe lived which administered with the greatest amount of judgment, and gathered physical and moral strength by a fuller appreciation of the laws of nature. In the early condition, the most powerful of the tribe gained supremacy over his comrades. Similarly, also, the remaining places of honour in the tribe were gained by those who proved themselves best able to defend the general interests. As might be expected, these offices were held by the strongest and ablest warriors.

At the present day we find that when a tribe, by the overthrow of its weaker neighbours, becomes more consolidated, and no danger from outside influences is feared, the internal policy develops, until the component members assume the

position of a nation. The population increases by the longer intervals of peace, during which the intellectual faculties find time for cultivation. The exercise of these capabilities is stimulated, by reason of the power conferred on those who, by their ingenuity, provide for themselves an easier or more ready method of enjoying life than the remaining individuals possess. The same rewards are given to the intellectual members as were conferred on the warriors in the early stages of development of the tribe. At first the tribes advanced by the survival of the physically strong over the debilitated or weaker neighbours. Afterwards, advancement also took place by intellectual competition between the individuals. Now, as further struggles for physical supremacy would lead necessarily to self-destruction, there would follow, not progress, but retrogression. Therefore the community of necessity must be governed by social laws and customs, of paramount importance to its welfare and advancement. The rewards which are now conferred on intellectual superiority, consisting in the individual increase of wealth or honour, are a potent factor in the causation of the gradual progress of man. Honour and wealth give power to their possessors. It matters not whether they be conferred by the Government, or whether they be obtained from the public in the shape of profits arising from superior acumen in trade. The principle of conferring rewards for individual excellence, whether of a physical or intellectual nature, must therefore be accepted as a just necessity. In proportion as we ratify and uphold the power represented by those cumulative rewards, so the more do we incite competition for the possession of them, so the more do we become the true friends and coadjutors of rational progress. Any undue interference on the part of the Legislature with those rewards, whether gained in times past, under old conditions of life, or gained in times present, under different circumstances, amounts to robbery or confiscation, and such violation of the laws of nature must inevitably lead to retrogression instead of to progression. In this connection there arises the important consideration, how these rewards must be adjusted and regulated in a fair and rational manner. How they can best be upheld in order to sustain their worth, without becoming the agents of tyranny, is the problem we have to solve. We have already seen that the rewards of superiority consist in the case of most nations in the acquisition of wealth, and the influence accruing from its possession. On the one hand, then, there is the danger of depreciating the wholesome influence of capital by mischievous legislation on the part of the representatives of

those who have nothing to lose. On the other hand, there is the danger of tyranny on the part of those who could misuse the power and influence they already possess.

In this country we have two rival parties: there are those who would uphold and maintain the security of wealth and power to the very utmost extent, and there are those who would, in certain ways and to some extent, depreciate and lessen the advantages in the possession of the more fortunate members of our community. The Tories and the Radicals represent the two extremes of these two parties. Fortunately for the welfare of our country, their power is moderated by the presence in the ranks of each of a moderating influence exerted by the Conservatives on the one hand and by the Liberals on the other. The views of these two sober-minded sections approach each other closely, and their differences of opinion are in reality but slight. The Conservatives effectually prevent the abuse of power, and while they actually uphold its representatives, at the same time they make no artificial barriers to prevent the acquisition of power by those who show themselves worthy of wielding it. The Liberals profess to give greater opportunities to those striving to attain the rewards of merit, while at the same time they uphold the possessors of power, in a somewhat less degree. As the power of the Radicals has at times threatened to assume greater proportions than heretofore, it is essential that their principles be investigated and scrutinised. We should endeavour to ascertain whether or not their actions would be in accordance with the natural laws regulating the welfare of communities.

They profess the equal natural right of *all* men to enjoy the good things of life, and in their eagerness to forward this end many of them show an inordinate zeal to minimise the rewards accruing to *individual* excellence. Their idea is that the whole community can progress together, and that great power or influence on the part of individuals over their fellow-men is to be deprecated. They disbelieve in the principle of that rational law that communities can only advance by the gradual progress of the individual units composing it. In their dealings with foreign nations it is their object to carry out the same principles. Patriotism gives place to cosmopolitanism, and the general advancement of the world is sought to be obtained by other means than by those dictated by the natural law of the self-aggrandisement of individual countries. The theory propounding the equal rights of mankind to enjoy the products of the earth is, as is well known, held as only partially or as more fully

in accordance with natural law by different Radical politicians. In its most extreme form this tenet would amount to Communism, and even a slight consideration of the laws of sociology will illustrate to us very clearly the false premisses on which the theory is based. In the first place we ask, has Communism ever yet held sway in a peaceable and thriving community? Is it possible that it could, without at once taking away the salt from all life, and rendering existence vapid and aimless?

Of all the delusive theories ever propounded by the leaders of the people, the principle of general equality is at once the most absurd, the most impracticable, and the most strongly opposed to the laws of development and progress. Probably but few of its exponents, save perhaps fanatics, ever truly believed in it. Now, how is it that such theories as these have appeared so plausible to the multitude, and how can it be that their influence has not long since waned? Because, we reply, that large majority of men who cannot attain to the excellence of their more fortunate fellow-creatures vaguely delude themselves with the belief that some great change forthwith ought to be made to equalise rank and wealth. Such principles appeal to the worst features of man's nature, they appeal to his envy, hatred, and jealousy, and tend to goad him on to wilful arrogance and unjustifiable assumption of merit not his own.

Perhaps the most captivating way of representing the general equality of man is by forming conclusions from our conceptions of abstract justice. Nevertheless, whether we view the incessant struggle for existence in the vegetable and animal kingdoms, or the gradual development of higher man in the early or later stages of the world's history, we find that the natural laws controlling and governing life of every description do not afford us examples of abstract justice, as we understand the phrase. Far from there being an equality or even community of interests, we find an incessant struggle of the individual against the community. If perchance in the higher and more intellectual civilisation this struggle is tempered by charity, it is through the exercise of this quality on the part of individuals that beneficial results will be effected. Voluntarily exercised by individuals its influence is reflected over the whole nation.

All progress would be arrested, all incentive to exertion would be removed, by the carrying out of inexpedient actions based on false but seemingly plausible ideas of justice. Where would be the interest in the race of life if the losers

shared, equally with the winners, the fruits of the hard-earned victory? Now, the Radicals of the present day in England do not for the most part hold the doctrine of perfect equality, but they would go so far in opposition to the natural laws of individual advancement as to succeed in harming the classes they wish to help. Their actions are not those of progress, they are reversionary or retrogressive steps, and can therefore have no permanent value. They wish to benefit one class at the expense of another, and so to interfere with the fixed laws of general advancement, as to destroy the natural incentives to exertion. Thus would they render, in their dread of individual aggrandisement, all forms of property insecure.

The laws of general advancement enact that the individual shall strive to progress, only when by so doing he can attain some object, a better position, or more power or wealth or fame, than was his before. Now, if the results obtained in the shape of influence or property were subject to periodical confiscation on the part of the State, for the benefit of those who are less fortunate, the incentives to individual exertion would of necessity be damaged, and retrogression of our nation would follow. We may expect the like evil results to be brought about, if the influence gained by industry and accumulation of wealth be minimised by unjust assumption of power and the exercise of tyranny. In the one case the results of industry are confiscated, in the other the incentives to industry are removed. Influence of one individual over another is the root of all true progress, and is the key to the advancement of all living creatures from the lowest to the highest forms. Whether this power be obtained and maintained by physical force alone, as in the lower animals and in the early stages of the development of tribes and nations, or whether, as in more differentiated states of civilisation, it is the superior intellect which gives the supremacy, the same principles still prevail in the shape of a constant striving to attain a higher position.

This universal competition in life obviously tends to the formation of innumerable grades of society, and it is upon the existence of these very grades, each a little removed from the other, that progress continues to be made by the nation. The artificial removal of the barriers and the merging together of the grades separated by them, would inevitably lead to stagnation, or to the re-formation of grades still more distinct. In other words, such retrogressive steps would end in failure, only avertible by the re-constitution of the previous state of things. The strife for

individual aggrandisement is the incentive for exertion on the part of the individual members of the community. This spirit of emulation, indeed, is the chief factor tending towards the progressive advancement of the nation. Now, in our country wealth and the power it confers on its possessors is attainable only by individual exertion of strength or intellect. No Government could honorably confiscate properties thus accumulated.

There can be no better condition of society than that in which each individual can gain coveted distinctions and power in proportion to his merit, and in which such acquisitions, when obtained, are thoroughly secured against attack or confiscation.

We have seen that the possession of wealth and power by individuals is necessary for the advancement of the community. Let us now consider how the Radicals would treat this wealth, represented by the possession of land and capital accumulated by industry.

The existing position of the land-question in England, more especially with reference to individual proprietary rights in the soil, the writer summarises in the main from some notes culled from an excellent article treating of this subject in the 'Popular Encyclopædia.' The actual tenure of property in this country recognises the right of individual ownership in a manner much more absolute and exclusive than a large and increasing class of Radicals believes to be right or expedient. Amongst these there are all diversities of opinion, but one leading dogma characterises all—namely, that the right of property in land belongs by an inherent and inalienable title to the people, and not to the individual. In its extreme form the principle amounts to Communism. When it is held along with the expediency of permitting individual property in land, it is of the greatest elasticity, and admits of any modification of tenure which it may be the will of society to impose.

It will be my endeavour now to prove that this theory, whether held in a greater or less degree, is absurd, impracticable, totally opposed to progress, and of everlasting detriment to the welfare of a country. If we look back on the pages of history, we can find no examples of a common property in land. The feudal law of Europe, in which our own territorial rights originated, had for its fundamental principle the right of conquest; and if we examine the land tenures of Asia, we shall find that they have mainly, if not altogether, sprung from the same source. Even among nomadic peoples there is a distinct perception and recog-

dition of the fundamental principle of property in relation to land. The most roving tribes among the nomadic races of Asia, Europe, and America, have always had their wanderings circumscribed by the claims of other nations of similar habits. History provides abundant support for the fact that these lands were not held by the tribes as common property, but that there were all manner of constitutions found among them. In the Highlands of Scotland, in a state of society not very remote from the nomadic, property was inherited by primogeniture, and the laws by which it was distributed were in the closest resemblance to feudalism, which may be considered as having been a stage of transition from the nomadic to the settled state. To turn from the light of history to the principles of justice and expediency. It is stated on the grounds of abstract justice that all men have an equal right to the soil. Although on many grounds this can be effectually disputed, its utter impracticability at once disposes of it. Supposing a community to have a settled disposition of property on any conceivable basis, how are the rights of new members, added to it by birth or immigration, to be adjusted? It only disguises the difficulty, to vest the inalienable right in the community, and not in the individual. Whether the monopoly be individual or collective, the effects will be equally disadvantageous to those excluded from it, in the shape of new members or immigrants. All not included in the original distribution, and all new members of the community, will be more effectually excluded from the possession of property than in countries where the possession of property is held by individual tenure, and consequently transferable by sale. These considerations compel all wise persons to admit the expediency of at least a modified individual tenure. But then many hold that this tenure should exist only for the convenience of the community at large, and should be liable to be withdrawn at will. To hold this theory, they must draw a distinction between property in land and other kinds of property, and this distinction they found on a theory of the origin of proprietary rights.

No man, they say, has a right to appropriate natural agents to his exclusive use; but the modification of these agents by labour gives a valid claim to their possession. Thus labour is held to be the true foundation of property; and while the soil (the common storehouse of natural agents) is held to be an inalienable common possession, an absolute right of property is supposed to be established in products taken from the soil by labour. Even a modified

right is created in the soil itself by labour bestowed on its improvement. Could any reasoning be more absurd and contradictory? Yet amongst the exponents of such a theory there was an undoubtedly able advocate in the person of John Stuart Mill. Even if this theory could be held good, it would only substitute for the previously existing difficulties the equally formidable one of distinguishing between natural and acquired rights. However, the distinction on which the entire theory is founded is wholly illusory. If the soil is in any sense common property, those who take anything from it, take from it what belongs to all. Their labour can give them no possible claim to appropriate what is abstracted from the common storehouse, for the value of labour depends entirely upon the possession of proper agents on which to exercise it. Again, many others (in fact, the majority of men) would be glad to bestow (and with equal right according to the above theory) similar appropriating labour on the soil, if that labour gave them possession. Then how would it be decided which labour should be selected? He who appropriates money or other portable property abstracted from the soil, moreover, appropriates to his own use the means of procuring subsistence, just as much as he who appropriates the soil itself. Labour without natural agents cannot possibly afford a foundation for property, and as the appropriation of natural agents generally necessitates labour, it is no solution of the question to say that labour justifies appropriation. In fact, manual labour can equitably claim only the least remuneration in any well-regulated society, and labour as a whole must, and always will, be dependent on capital. Capital exists in the hands of an individual, either by superior excellence on his part, or on the part of his ancestors; and, if equal advantages be given to those who have not attained to that excellence, where is the incentive to industry on the part of the labourers? By the laws of nature nothing can stand still. All must advance or degenerate. If the labourers (as representing the mass of population) participate equally with the representatives of individual excellence, the bulk of the population must attain one dead level, from whence degeneration must ensue.

In fact the only source to which the appropriation of property can be referred is the universal instinct of appropriation in the human mind. The fact of appropriation needs no justification. Man finds natural agents suited to his purposes. There are no rivals save his fellow-men capable of disputing them with him, and no difficulty

occurs, until disputes arise about their respective appropriations; and this difficulty is to a great extent met by a natural principle of justice, which inclines men to respect each other's appropriations. The first appropriations of land may have been so far collective as to have been made on behalf of family groups; but, as the father is the natural head of the family, they became individual appropriations in his name. When combination for cultivation of the soil became indispensable, a head, an individual director, and finally a proprietor naturally sprang from such collective appropriations. Thus the distinctive principle of property is a result of social combinations, and is centred in the individual showing at the time the greatest excellence. All history attests a uniform course of development from this early appropriation, and the end is exclusive *individual* possession. In all changes, individual interest, represented by possession, in the end proves stronger than all mere customary or abstract rights. In ancient and modern history we shall find the same constant tendency to a fixed determination of property. In all states of society the desire of appropriation is a perennial source from which the claims of proprietary right incessantly spring, and this natural impulse is sufficient to account for all the proprietary rights existing in the world. This origin of property renders it clear that proprietary rights are not derived from the State. *The State does not give the instinct, nor can it take it away.* Although, however, the right of holding property does not originate with the State, still property can only be permanently retained and profitably exercised through the protection which the laws afford. Hence, whether land is now gained by superior industry on the part of individuals or their descendants, or whether it be held by direct descent from those who originally obtained it by appropriation under different or more elementary conditions of life, matters nothing to the State. Proprietary rights require the sanction of the Government of the time being, and when once such sanction is given, the Government must protect those rights. It may reasonably, however, make conditions with the holders as to the terms on which it shall do so, but on no different basis to the conditions it makes in the protection of any other property. It should be guided not by abstract justice only, but also by the possibilities of the case. To the question, "*What ought a Government to do?*" must be added, "*What can it do?*" It is clearly not expedient for a Government to trace up existing rights until it finds a pure title, for this is impossible, and it ought not to attempt to

redistribute property on any abstract principle of justice, for this is equally impossible. The principle of original appropriation, added to continued possession for a length of time, is assuredly too strong for any party to disturb, since, together with the desire of appropriation in the minds of all, there has always existed the counterbalancing disposition to respect the appropriations of each other. Hence it is by strengthening these principles, namely, by rendering property at once secure and at the same time easily transferable, that the happy medium will be found betwixt justice and expediency. Government cannot go far back to correct frauds or violence in appropriation, if possession has existed undisturbed. It must at some point recognise a prescriptive right; but it may correct future appropriations, and enact that they must be in accordance with the strictest justice. Priority of appropriation, with effective possession, is thus the highest source to which the right of property can be traced.

That the actual disposition of property in this country should have given rise to theories adverse to this view of the fundamental law of property, demands some notice of grounds on which this disposition is objected to. The object of proposed modifications in the tenure of property is to secure a much freer subdivision of it, and the various advocates of the claims of those who are excluded from holding property, touch the fundamental principles of proprietary right much more closely than others. They all regard the subdivision of property as superior to any theory of tenure, but profess to regard some form of compensation as necessary. All compulsory sale of land, however, renders compensation to a great extent illusory. To establish peasant proprietors, however, is their end and aim, and to give the people a greater interest in the soil, in spite of all existing forms of tenure. Setting on one side the injustice to the present holders, and the interference with natural laws of selection and development, and with the fundamental laws of proprietary rights, this redistribution of land in the manner advocated is absurd in the extreme. Unless we revert to a more primitive civilisation in which the agriculturist supplies his own collateral wants, and abandon combination in labour, the non-agricultural population will bear about as large a proportion to the agricultural under the new arrangement as under the old; and in case we do revert, this difficulty at once presents itself. Either, society, in redistributing property, must retain the right of future redistribution (and then the stimulus to exertion will be gone, for there will be no security of tenure), or it must

give absolute right of property, and then the differences of individual capacity and other accidents will rapidly lead to the inequality of distribution which now exists. It has been abundantly proved in England from practical experience of late years that small holdings, and even farms of 100 to 200 acres, are insufficient to maintain a class of farmers of sufficient education and science to render total results beneficial to the country. In Ireland we have not as yet seen the end to the misery and general stagnation which may be said to be largely due to the subdivision of the soil. Combination of labour, which can only be exercised to the full extent on properties of considerable size, has an immense advantage. The security a well-paid labourer feels in the fact that his industry will have a certain reward in the shape of certain wages should over-balance the fruits of extra labour, and the extra quality of that labour expended on property belonging to himself. Then, again, peasant proprietaries must either pay well, moderately, or not at all, and in any case the result will not be in accordance with the ends desired by the advocates of the scheme. If it is to pay well, taking into consideration the varied qualities of industry, and the varied character of all men, the results of farming small holdings must vary, and the industry shown by the best will result in the gradually increasing extent of the properties held by them. Knowing that the desire of accumulation is the mainspring of industry, and that there is a constant gravitation to a distribution of wealth regulated by industry alone, we see it necessarily follows that the subdivision would result in the very accumulation of territorial wealth which its advocates desire to abolish. By some, however, the peculiar doctrine is held that the right of transmission to heirs is not an essential part of the principle of private property. If this right were questioned, a complete change in the motives to industry would, of course, inevitably ensue.

No conception can be made of an organisation of industry from which the right of succession is withdrawn, and all the force of the most despotic Government would be insufficient to maintain it. In fact, any interference with the private rights of any individual to leave property to his children would interfere too much with natural incentives to industry, and would be a violation of free development. Therefore, even if it could be proved that small holdings were good in themselves, the very fact of their being good would soon cause a vast increase in the extent of territorial wealth in the hands of individuals. On the other hand, the

fact that, in countries where this principle is carried out no large properties result, is a proof that it does not pay, but keeps the holders themselves either in a state of level stagnation, or in the worse state of semi-ruin. Now, supposing its tendency is to keep the holders in a state neither of increase nor ruin, what advantage is it either to them or to the nation? Would they not be far better off as labourers, having a prospect, at least on extensive farms, of gaining higher positions, if their industry and talent deserved it? Imagine 1000 small farms of 50 acres, owned and tilled by 1000 small men, with no hope of making more than a living, and always filled with anxiety lest a run of bad seasons should ruin them. On the other hand, imagine these same men as workmen on 50,000 acres of land, farmed and owned by a company, capable of adding science and capital to combination of labour, all well paid, each with a chance of rising to a higher position in the employ of the company, according to their talents and industry! What is there besides sentimentalism in the possession of small holdings, that should cause necessarily imperfectly educated men to be superior to science and capital? It would be well if large tracts of land were held by large companies, so that every combination could be taken advantage of, the produce of the soil conveyed more directly to the consumer, and the great loss to the land in the wholesale waste of manures in towns prevented. All these three advantages could be gained by farming on a scale hitherto never attempted, and backed up by capital and science. Instead of going back to primitive farming, instead of retrogression, we should advance to a higher condition. This cannot well take place until the maudlin sentimentality, as regards land, of certain economists gives place to a more healthy view of land as property in no way distinct from other kinds of possessions. This sentimentality would lead to confiscation of the private rights of property, insecurity to the results of industry, despotic interference with the rights of the individual in the matter of succession. For what end? To give origin to a number of independent small owners of land, doomed in most cases to level stagnation or gradual ruin.

A minute examination into the many details concerning the land-question shows very clearly the impracticability of the maintenance of a thorough subdivision by any party in the State, without resorting to tyrannical interference with the private rights of the individual. Moreover, it is evident that the partial introduction of peasant cultivation would serve no useful purpose whatever. Furthermore, all those

politicians who advocate such measures commit a twofold error. They excite in the minds of the labouring classes anticipations which can never be fulfilled, while at the same time they threaten the security of property, which is the mainspring of industry.

With respect to other forms of property, the principles expounded above are equally applicable. Individual rights, as being the results of individual excellence, should be protected by the State; and, so long as they are exercised with a due respect to the rights of others, they must be held free from despoliation for the benefit of those members of the community who have not attained to them.

Taxation of wealth is legitimate for the purpose of maintaining law, order, and health, in the community; for maintaining the defensive strength of the country, and to some extent for establishing institutions which will add to the material wealth of the nation. Any taxation of wealth in order to raise funds wherewith to endow one class at the expense of another, is an interference with the natural order of rewards for excellence, and would prove to be a curse rather than a blessing to those intended to be benefited.

As the Radicals at the present time are not contemplating any direct attack on property other than land, it will not be necessary to allude more closely to this part of the subject. Yet we may with advantage turn for a moment to examine the indirect attack they propose to make in the matter of free education.

Taxation for the purposes of compulsory education may be said to be legitimate, inasmuch as, by increasing the intellectual power of the masses, it would add to the wealth of the country; but the manner of levying the taxation should be seriously considered. Although free education, a misnomer well calculated to deceive, would lead to the imposition of an increased School Board rate on the classes it is intended to benefit, nevertheless, it would still more closely affect the owners of greater wealth, and this in an unfair degree. They would have to pay for the education of those well able to pay for themselves, for the children of paupers are already provided for by the existing law. Such a method of legislation amounts to the confiscation of the results of individual industry, and is an instance of proposed interference with the maintenance of the private rights of the individual and the security of property. Now, how will the masses be benefited by such measures? Certainly not in the matter of education, for that is already compulsory.

They may be benefited pecuniarily for a time, but not for any lengthened period. Inasmuch as the all-powerful force of nature in the form of individualism, as represented by capital and power, must ever rise superior to any collective agency of a minor nature, so would arbitrary confiscation carried out now, recoil at a later date on the heads of the classes now temporarily benefited. In proportion to the extent that capital is taxed to give artificial support to labour, so much the less will it be able to remunerate labour for work done. In a word, free education will result in diminished wages, and the labourer will in the end be no better off than before. If this were all the harm such legislation would cause, it would perhaps not be a matter of such great moment; but, unfortunately, in the process of readjustment of wages, no account could be made of the evils thus engendered, viz. the interference with the stability of trade, which it can ill afford to bear, the ill-feeling stirred up between master and man, and in fact all those evils attendant upon any struggle betwixt employers and employed.

This cry of free education on the part of Radicals is on a par with most of their policy, the promise of a rose with a thorn in it. The people may find not the thorn until they have agreed to take the rose.

Turning now from private property to property of corporate bodies, we still see the same principle of confiscation pervading the Radical doctrines. Some would disendow and disestablish the Anglican Church. On no principles of justice can the disendowment, nor on any principle of expediency can the disestablishment, of the Church be defended. Without entering into sectarian discussion, we may say that it has been an established axiom from time immemorial amongst all peoples that it is expedient that some form of religious belief should be held by the populace, in order to afford a check upon the animal passions, which would otherwise interfere with intellectual development. Although at the door of religion in the past may be laid some of the greatest evils which have afflicted mankind, although it has been employed by priestly tyrants to stifle freedom and progress, although oft it has been merely a hypocritical cloak for personal aggrandisement, yet no one can deny that, in recent times, it has been of immense advantage in curtailing the animal passions, which would have led men, in their jealousy of one another, to mutual extermination. In addition, the principle of an all-powerful guiding power has been inherent in the minds of all from the earliest times of barbarism to

the present day. Acknowledging this principle, legislators have accepted its aid in government in greater or less degree. Now, in England, the State has for many years been united with a religion not intolerant, not despotic, but with one that has used its immense power for infinitely more good than harm. It has helped the State under many trying difficulties, and has truly advanced, as the people it taught have advanced in general knowledge. We need no greater proof of this than the confidence shown in it by so many wealthy donors. It has not confined its treasures to itself, but has given largely to the poor. The doctrines it inculcates are Protestant, and in no vital point at variance with the belief of the majority of the people. Even if we granted that religion is only a necessity, inasmuch as it neutralises the effects of ignorance, can it be said that England is sufficiently advanced in science as yet to dispense with its aid? Again, even if this were the case, can it for one moment be said that the English people have as yet come to this conclusion, and have lost all their faith in God?

Granting, then, that religion is a vital necessity in England, how can its interests be better served than allowing the best exponents of its truths to remain in connection with the State? How can the interests of the State be better served than by remaining in union with a religion at once so liberal and beneficent in its actions? Even if abuses exist, a reformation of those abuses were better than abolition of the union. What ends is it supposed would be gained by disunion? Is there any substitute that can be proved to be better, or has any other religion in England an equal claim on the State for protection? Either, according to the Liberationists, the union is detrimental to the State, to the Church itself, or to the people. If religion is good at all, and if, as nearly all England believes, the Protestant religion is the purest, and no better substitute can be found, why is it not beneficial to the State to be in union with it; and if good for the State and good in itself, why is it not equally as good for the people? The Church itself is the best judge of what is good for itself, and its voice is universal in favour of the continuance of things as they are.

If it is a cry of Dissent alone or mainly—of a body of men professing the same God, having as their object the same ends in view, namely, the propagation and maintenance of the same Christian religion,—then shame be on those who, through their jealousy and narrow-minded bigotry, would help to destroy their brethren in work. For undoubtedly the effects of the disunion would be a terrible

blow to Christianity in England. A religion protected by the State is bound to have more weight with the people. When that protection is removed, many of its members would cast off all appearances of religion, and, unprotected by its influence, and having no science to guide them, they would help to swell the ranks of atheists, the enemies of Church and Dissent alike. We would rather believe the whole movement is actuated by the atheists themselves, who, in aiming a blow at the greatest religious institution of the country, hope to loosen the hold religion still has over the minds of the nation. By exciting the dissensions, petty in themselves, which exist between the Church and Dissent, and appealing to the love of gain all men possess, they attempt to prove that part of what the Church now possesses would fall to the share of Dissent. Vain delusion, as Dissent will find, if it takes this specious bait! The extreme injustice of disendowment needs no further explanation, if reference be made to the principles already advocated in a former part of this chapter.

The question of the disestablishment and disendowment of the Church cannot be better dismissed than in the words of Macaulay :—"On these principles we conceive a statesman might firmly oppose all attempts to destroy her. . . . He may think that she teaches more truth with less alloy of error than would be taught by those who, if she were swept away, would occupy the vacant space. He may think that the effect produced by her beautiful services and by her pulpits on the national mind is on the whole highly beneficial. He may think that her civilising influence is usefully felt in remote districts. He may think that, if she were destroyed, a large portion of those who now compose her congregations would neglect all religious duties, and that a still larger portion would fall under the influence of spiritual mountebanks, hungry for gain, or drunk with fanaticism. . . . He may think that the advantages which we have described are obtained (or might, if the existing system were slightly modified, be obtained) without any sacrifice of the paramount objects which all Governments ought to have chiefly in view. Nay, he may be of opinion that an institution so deeply fixed in the hearts and minds of millions could not be subverted without loosening and shaking all the foundations of civil society."

We have seen in what manner the Radicals would deal with the wealth of the country, and it will require little judgment to see in how great a degree their policy is antagonistic to the ruling law of nature. In many cases, it is

true, their actions would defeat their own ends, for the laws of nature, when arbitrarily violated, will reassert their sway with greater force than ever. In all such instances, the disappointment would prove all the greater to the persons expecting to benefit by their confiscations, and at the best an arrest of progress would ensue. Yet inasmuch as their policy holds out baits of a tempting nature to those who cannot see the hooks, they will always find followers amongst the ignorant. It is to the ignorant they appeal, and since in numbers lies strength, their party will always be a formidable one. It is to the more thoughtful of the community that this paper would now appeal; to those who must see that the above programme as put forward in respect of land, education, and the Church, means confiscation of the private rights of individuals,—the proposal that undue help should be given to one class at the expense of others, and robbery of one of the most charitable and beneficent institutions the world has ever seen. If the principles here inculcated are right, if they depend truly on the inviolable laws of nature, then Radicalism as thus understood means retrogression, and its doctrines a reversion from liberty to tyranny.

CHAPTER XI.

“In what Sense and to what Extent can the Evolution Theory be reconciled with Sound Philosophy?”

AMID much diversity of opinion on all subjects, it is of great significance to remark, that of the thinkers and philosophers the world has produced, no one has ever given out that he has fully and finally settled any of those great and crucial questions which have always exercised the mind of man, and will, in all probability, continue to attract his most steadfast attention, so long as he continues to exist on the face of the earth.

Having regard, then, to the observation and recognition of our very limited powers thus implied, we may surely derive two highly suggestive hints; for, while on the one hand it may well be concluded that it is literally impossible thoroughly to solve what is in its nature essentially insoluble, on the other hand the very consideration of such views

should the rather impel us the more readily to accept provisionally all that does undoubtedly come within the sphere of human thought and experience.

We shall thus receive, accept, and fully acknowledge, that idea of causation which has been found by the ablest philosophers to present the strongest appearance of truth, and to be attended with the very best results, when rightly applied as a basis of morality, to the formation of rules of conduct.

In fact, it may be said that, in so far as this conception of evolution forms, perhaps unconsciously in most cases, but still almost universally, the chief guide to our actions, and is, to the greatest extent, the determining factor in the case of the most logical and the most successful, it is to be considered as presenting evidence of a very powerful character in favour of itself.

It is to be regretted and deplored that the earnest desire to learn what we can, respecting that which admits of being known by human beings, and the eager pursuit of science thus engendered, indubitably develops a tendency to magnify unduly our own powers, and would seem to render us, from time to time, the less able or the less willing, to acknowledge something beyond and above ourselves. Unfortunately, the scientific investigator is thus sometimes drawn away from such recognition, and is prone to lay exaggerated stress on systems, inductions, and theories, generalisations, and hypotheses.

Again, although observers of natural phenomena have not, as a rule, exaggerated the truth and importance of their ideas, or invested them with more savour of reality than would accord with the tenets of sound philosophy in the strictest sense, it must yet be confessed that from time to time, in the heat of argument, perhaps, or in the intensity of imaginative speculation, there may have been afforded, on the part of some at least, an apparent justification of a charge of entertaining opinions, far from congruous with a rigid impartiality of demeanour and belief.

Nevertheless, at all times much excuse must be made for the too emphatic enunciation of truths, which are at first unacceptable by the majority of men.

One reason in this particular case (certainly not the least) deserves special mention. It is that a decided and uncompromising one-sidedness and opposition has been not seldom displayed, by the adversaries of scientific work, and its results in general. There have been, and are, such bitter opponents of advance, and thus a spirit of intense and

acrimonious party feeling has been imported into a question which, above all others, requires calm and unbiassed attention and judgment, thus embittering controversy, and driving both sides to the holding and expression of extreme views, to unwarranted speculations, and vain imaginings.

It will be the more obvious the more we think about it, that the idea of a definite sequence among natural phenomena, is the one great central one of the human mind.

We see, on all sides, so many instances where the connection between what precedes and what follows is an exact and invariable one, that we have not the least hesitation in saying:—‘these particular effects follow, and are strictly dependent upon, those particular antecedent causes.’

For the idea of evolution, only one step more, one further advance is required, for we have only to allow what must be logically admitted, viz.: ‘That the aggregate of all which exists to-day, has gradually followed as a natural consequence, from the aggregate of all which preceded it in the far-off past,’ or, in other words, ‘that the various forms in which matter and force present themselves to our consciousness to-day, have resulted naturally (just as known effects follow known causes) from the pre-existing and, in all probability, simplest state of things.’

Although we cannot always trace the exact connection between different groups of phenomena which have had similar causes, our inability to do so manifestly does not vitiate the general conclusion, otherwise sufficiently authenticated, that such connection has existed.

The grand results of observation and inquiry into all branches of knowledge have been, since about the year 1837, and from that time up to the present, when the evidence is increasing daily, gradually embodied and organised into one uniform law, one great theory, one complete generalisation, which has revolutionised the whole character of human thought.

It was then first being found out that all we know goes most emphatically to prove, that the law of causation, which all men necessarily recognise to a great extent, holds throughout every part of nature, and has always so held.

We argue strictly from facts within our experience, when we say that all things as they now exist have, in all probability, arisen gradually according to a natural law of evolution, that is to causes, with which we, having regard to an observation of unvarying sequence, are made acquainted from hour to hour, and from minute to minute. And, we

conclude that the universe and its contents, as they present themselves to our consciousness at this present time, have been gradually formed from the simplest forms of matter.

Further, we hold that the successive changes, which have culminated in the present state of things, have not been fortuitous or haphazard, but that they have rather necessarily followed one another, or, as we say, have been connected as causes and effects; and although, when we attempt to solve the intrinsic nature of such changes, and to explain the relation which subsists between antecedents and consequents, we are inevitably involved in numerous perplexities and difficulties, still the necessary character of the relation between a phenomenon which invariably precedes and another which always succeeds it, is so assured, and so bound up with our methods of thought, that it is not only absurd, but simply impossible to ignore it or throw it aside.

We cannot elude the recognition of this idea of the necessity of causation; it is quite impracticable to think of consequents and antecedents which are universally connected, as being irregularly related or not necessarily related at all: any attempt to do so necessarily leads to an inextricable confusion of thought.

We are compelled to admit that every occurrence is followed of necessity by another, and this again by another, and so on, each successive change being of corresponding strength and character.

So well known and so widely accepted is this truth, that people would smile if one should ask, "Why should a cause produce a corresponding effect?" So marked, so irrepressible is this idea of the absolute and invariable connection between what always precedes and what always follows, that one who doubted it would, in the eyes of the majority, stand convicted of a deficiency of common sense.

Now, this conception, which, of all others, as we have seen, has been and is most universally current, is therefore one of paramount importance, underlying, as it does, all other beliefs. It is the idea that there is some fixed law in Nature to which all things conform. It is that of the necessary sequence of those phenomena, which invariably follow one another. This is perhaps the most fundamental of all human conceptions.

If we attempt to analyse our intellectual operations, if we try to arrive at some understanding as to the conditions which must be fulfilled before we can say we fully comprehend any given thing, we shall always find that the idea of necessitated sequence among the phenomena characterising

it, at different periods of time, underlies all our impressions respecting it.

The origin of the universe from the evolutionist's point of view must be supposed to have been throughout a process of necessary sequence between gradually perfecting changes; for though the idea of degradation, and that of dissolution, are connected with that of increasing perfection and integration, still, as ordinarily understood, evolution means, on the whole, a decided change in the direction of advance.

Now, before the theory itself can be discussed, there must be postulated a definite starting-point of some kind, such as the presence, in space, of matter in a highly diffused form; and, further, we must suppose the matter to be endowed with the property of mobility, and subject to the law of universal attraction. With regard to the property of mobility, it may be incidentally remarked that we can only think of matter in terms of force. In other words, our conception of matter implies, and in fact really is, a conception of force. Probably we cannot reduce our ideas further, or form any more abstract conception of a beginning.

Primitive atoms, or minute particles of matter, endowed with the capacity of exerting force, are supposed to constitute the source from which all things, as they exist to-day, have been formed as direct results. Evidence has been collected from all sides, which has helped us to reach one grand result of human observation and inquiry. Gradually and slowly thenceforward, thus illustrating, in its own genesis, the truth of its own meaning, one great and grand induction, one complete generalisation, has been arrived at.

Men have learnt to realize more clearly than had been previously possible, that that same law of causation which has always been necessarily recognised to a great extent in all ages, and by all men, holds throughout every department of Nature, and has always so held; and we now conclude, putting the separate and distinct generalisations of astronomy, of geology, and of biology into one, that all things as they now exist have, in all probability, gradually arisen according to an ultimate natural law of evolution, that is, to a natural sequence of phenomena, with which we seem to be made acquainted most unmistakably on all sides. In other words, the universe and its contents, as they present themselves to our consciousness at this moment, have apparently been gradually formed from the simplest forms of matter endowed with the property of exerting force, and occurring in the vast expanse of limitless space.

Changes followed changes, effects followed causes, the effects becoming again in their turn the causes of succeeding effects, and so on.

The primordial atoms, in virtue of their tendency to aggregate according to the law of attraction, gradually gave rise to the following successive stages, viz. that of nebulous masses and rings, of gaseous spheroids, of liquid spheroids, and finally of liquid spheroids externally solidified to a greater or less extent.

The earth, the sun, the moon, the planets, and all the host of heaven, were, according to the nebular hypothesis, which is part of the general theory of evolution, the results of the condensation, millions of years ago, of the primitive nebulous vapour, or extremely attenuated matter diffused throughout the wide expanse of space.

It is almost needless to add, so widely recognised now are the laws of the indestructibility of matter and motion, that there was at this time just exactly the same amount of matter and of energy as is contained in the universe of to-day.

Both, however, presented different characters, presumably existing in the very simplest forms.

The applicability of the theory of evolution to the case of living organisms is now practically admitted by nearly all the ablest biologists. Obviously this was the most difficult as it was the latest extension of the idea. The peculiar processes exhibited by living things were clearly less easily explicable than many of the more *mechanical* phenomena occurring in the outside world.

Evidence has been collected by Darwin and others, of a most complete and overwhelming character, to show that organisms admit of almost infinite variability, and of marvellous adaptability to changed conditions. The facts of morphology and of physiology; the facts of embryology; the facts of the distribution of organisms both in space and time; the methods of classification adopted in the absence of preconceived ideas—all point incontestably to gradual processes of orderly change, and receive their most complete and satisfactory explanation, when understood as having been brought about and necessitated by slow but sure transformations of a necessary, a gradual, and a progressive character.

Similarly, the sciences of astronomy and geology, as well as those which make up biology, point to the same interpretation, to the same idea.

In short, it is not too much to say that every single department of knowledge and inquiry furnishes independent

testimony to the same effect, receives its best explanation on the same plan. And when we couple with this that idea with which we began, viz. that the theory of evolution is, after all, but an extension of the law of causation, which all men do practically admit, it must surely be confessed that its truth ought to be provisionally admitted without hesitation.

Having then cursorily indicated what is meant by evolution, our attention must now be strictly confined to the points proposed for discussion.

Three questions occur :

Can the evolution theory be considered as an entirely satisfactory, final, and ultimate explanation of the origin of things?

Does the evolution theory aid us in any sense to dispense with the idea of a First Cause?

Is it to be regarded as the best relative explanation we can provisionally offer of the mode of working, the method of procedure followed by an Unknown Power, an Infinite and Eternal Energy, an Almighty and Supreme God?

To the first two questions a distinct No must, I think, be returned, while to the third an affirmative answer may be given without the least shade of hesitation.

Throwing aside the absolute, and dealing with the relative alone, the theory may be considered final, as far as we are concerned.

In this qualified sense it has the very highest warrant which any idea can have, and it is important to observe that those who are, and those who have been, most eminent in scientific work, are, as a rule, the most eager in their support and acceptance of it.

Very few would now advance seriously a belief in Special Creation.

The discussion between the idea of a gradual, and the idea of a sudden spasmodic creation, may almost be said to be a barren one, and scarcely affects the real point at issue.

It must be, and is generally acknowledged, even by the most stringent supporters of the cosmogony of Genesis, that while science is not in agreement with it when literally and exactly understood, still, if the Bible-narrative is regarded as in some degree symbolical, the discord becomes far less apparent, and in fact may be said altogether to disappear.

Let us approach the question from a different standpoint, and take a bird's-eye view of another aspect of our subject.

There are among men two broadly distinct modes of thought. Some see unity in all things, and in the universe

at large; some rather regard the multiformity. Clearly the latter is most apparent, and to a superficial observer perhaps alone recognisable.

Hence the most marked appreciation of it is, as we should expect, characteristic of the uncultivated. The savage displays it in his poly-fetishistic conceptions, from which gradually, as more culture is acquired, emerge the poly-theistic beliefs. Each occurrence is thought to be attributable to a special guiding agency, to a person more or less ghost-like, more or less like himself, and the spirits of his ancestors made perfect.

How is it that primitive beliefs concerning natural phenomena are thus explained? Can we account for it? Let us cast aside for a moment, so far as we can, all preconceived opinions, and attempt to explain any natural occurrence, *i.e.* any event which is not directly related to ourselves, and does not immediately concern us. What can we say of it? How can we possibly set to work to think about it at all?

It is evident that we must think of it, to some extent, in terms of our own conscious existence. One absolute certainty, some, I believe, think one only, must be manifest to every man. No man can in his full senses ignore, or forget entirely, or disbelieve in his own existence.

Of all things known this is most true and most thoroughly present to the consciousness of all. As we grow older, as mankind becomes more highly cultured, we lose sight of the importance of self, while concomitantly we recognise what a very small portion of the sum of things each one is. And when we begin to acknowledge this, at the same time we must see dimly, and discern darkly, that there is some great reality, some wondrous mystery, some eternal energy, perhaps some conscious existence, above all, and beyond all. It seems almost blasphemy to attempt to define or to understand; so great, so wide, so grand, so wonderful and powerful must He be.

The savage, then, considers all thing which happen as produced by agents, essentially similar, though more powerful than himself. This is exactly what might be expected. It is the only way in which he can think, incapable as he is of very abstract notions. He has a clear and ready perception of the manner in which he wills to do a thing, and it is done. He knows that some who were in life once are now no more around him, he thinks of himself when dreaming of far-distant scenes. All these vaguely remind him that there may be invisible powers, of which he knows nought, and thus he explains all mysteries by the

firm conviction that this is so, that all things going on are due to hidden men-like beings.

Likewise in modern times and even now, we have the notion, more or less conspicuous, that man is the centre of creation, the wheel by which the whole world rolls.

Not so very long ago, speaking comparatively, each event in the outside world was thought to bear a direct and most important relation to man's personal benefit or disadvantage.

The flights of birds determined the movements of armies, and even the fates of empires were settled by what men thought to be inspired vocalisation.

Even now, some, while believing that epidemics are due rather to the direct interposition of Divine wrath, than to our neglect of sanitary conditions, manifest the idea that the one Supreme God is to be regarded as a vengeful kind of human being, whose thirst for retaliation is as great as His jealousy, and His sense of injury, when neglected by His creatures, and deprived of their worship.

Now the theistic evolutionist postulates one Great Cause, one Supreme God, who has worked for ever, and will, so far as we can imagine, for ever work according to laws, which will in His own good time produce the best results.

True it is this does not commend itself as an entirely satisfactory conclusion; but it is probably the best conception men can frame. It is the expression of the unity we must see and feel.

In place of many gods we have One, in place of many unknown causes working spasmodically and fitfully, we have One working uniformly and regularly, and to our minds more naturally. This view is in accordance with those rules of conduct, which most of us have, unconsciously perhaps, and more or less exactly framed for ourselves. We know that every action we carry out seems, as far as we can judge, to be followed by definite results. If good, it has good and beneficial effects; if bad, bad comes of it.

Instead of regarding the bad result as vengeance exacted, we regard it as a natural law, which the Author of all things has ordained; and the good results are similarly explained. This is a great gain. We ascribe no small and necessarily bad motives.

But when we have assumed this complete idea of connected and continuous causation, from the most simple forms of matter as seen in the nebulæ, to the complex universe, with its extraordinarily varied and wondrous contents of to-day; and when we have substituted one Great Power, Unknown and Unknowable, for the many

spirits of the savage, which he supposed to be respectively the causes of the occurrence of each phenomenon, what have we done? Instead of looking upon the unknown factors, as innumerable and indefinite, we now consider them all merged into One.

Of this ultimate conception, it is as impossible to rid ourselves as it would be unwise, had we the power to do so. In all creeds and in all beliefs, in some form or other, this idea is present, from the most anthropomorphic, to the most abstruse religious and scientific assumptions.

Even those who regard the evolution theory as final—and there are very few, if any, who do so—are compelled to have recourse to the most unsatisfactory of all factors, that of chance. And even a belief in chance implies an acknowledgment of an Unknown Power.

In fact this belief in One Power at least, may be said to be the one, in possessing which all men agree.

Agnostics may be cited as an exception, perhaps, but of all men who really try to find an ultimate explanation of things, it may be said that they can put backwards in thought the idea of the action of a Power, to any point of time, however distant; they can diminish in thought the original influence almost to *nil*, so that instead of the belief in design the absurd assumption of aimless chance is substituted; they can state that the influence was exerted only at the very beginning, that it is one, undivided and indivisible; but still none the less it remains as one of the indispensable conditions of thought.

Though, then, we must accept the evolution theory as being the nearest approximation to truth which we are capable of gaining, let us always be careful to consider it as indicating nothing more than a method of procedure of an Almighty Power, to whose power and wisdom no limits are to be ascribed.

To maintain that evolution affords any real *ultimate* explanation, of the origin of the universe and of the difficult problems of life is entirely untenable.

To the idea there must manifestly be linked that of design, for to imagine that all things arose by chance is utterly incomprehensible and absurd; in fact, it is at once a statement of the proposition which it is desired to prove, and at the same time an admission, though perhaps an unconscious one, that the action of some Unknown Power must be acknowledged.

In evolution we have the dim notion of a method, and when this method is realised the question still presents

itself, What is it that guides this method?—what causes this gradual growth presumably in the direction of advance and progress?—what causes evolution? Some may be satisfied with the answer—"We do not know." Let us, however, while acknowledging this in some sense, as we are indeed compelled to do, look for a higher ideal and boldly acknowledge that factor, the Almighty and Inscrutable Power, which, try as they will, men cannot refrain from postulating in some form at least.

The interest and importance of the questions we have set ourselves in the foregoing pages, it is impossible to over-estimate. All who are acquainted with the methods and results of modern thought can appreciate the immensity and extent of the influence which has been exerted upon it, by that product of generalisations of different branches of knowledge, which is generally known as the evolution theory. A huge mass of evidence, gathered from all sides, leading as it does uniformly to the conclusion that the universe, as it exists in its totality to-day, has been gradually and imperceptibly formed from the simplest forms of matter and force of a far-distant and unfathomable past, cannot be considered as of small moment. We cannot lay aside as of slight esteem, or ignore an induction, which is to be recommended as being after all but a higher expression of that general law of causation, so universally and inevitably recognised and admitted by all men. On the other hand, notwithstanding the general plausibility of the scheme of creation as thus understood, it is not to be unthinkingly regarded as a final, complete, and fully adequate explanation of the origin of all things. Such a consummation of human inquiry, however desirable, must ever remain impossible, since by reason of the narrow limits of his understanding and intelligence man must necessarily be precluded from solving the infinite. The real state of the case, then, would appear to be very simple. On the one hand there is no possible escape from the conclusion that, in view of all that has been urged for it, the idea of evolution must be accepted. Nevertheless, it would be utterly inadmissible and palpably absurd to look upon it as entirely satisfactory and final. And thus it comes about that while the extreme scientific party would do well to withdraw from those untenable outposts which philosophy and theology alike condemn, theologians must feel themselves compelled to recognise that in the evolution hypothesis men have found a marvellous clue to the process of creation. In this sense can it be accepted to the very fullest extent, and those who

thus receive the doctrine will find it assume a very practical shape, so much so indeed that the ideas they form on all subjects, and on every occurring circumstance, will be very appreciably simplified and improved; as more or less completely all processes of change are considered as parts of one grand scheme of wondrously directed and designed advance.

We may conclude by again insisting upon the importance of arriving at a definite decision respecting this momentous question. The evolution theory has in reality revolutionised modern thought, and nearly all recent literature contains this idea as a tacit assumption. It is now to be *provisionally* regarded as an established induction, and there is scarcely a single department of knowledge to which it is not applicable. Commencing with the presence of primitive matter in a diffused state throughout space as a datum, we come gradually to the following successive stages, viz.:—The formation of nebulous masses and rings, of gaseous spheroids, of liquid spheroids, and of liquid spheroids externally solidified. The changes which the earth has undergone, before arriving at its present configuration, may be arbitrarily distinguished as astronomical and geological. As to the origin of life on the globe, it is to be recollected that the transference of inorganic into organic living matter must have been a process of the most gradual change due to the conditions then existing. At no definite period could it have been said:—"Here is the first living thing;"—for living things as known to us in their lowest forms present scarcely more than mechanical processes, and it is possible that if we could, by the aid of our microscopes, find the lowest forms of life, we should be able still more distinctly to observe the relation of vital forces to other forces known to us. This assumption does not, however, commit us to the belief in spontaneous generation at the present time, for which we have no evidence. The series of forms which connect the lower organisms with the highest would, if represented fully, give us a sort of tree of life, so to speak, of which the branches and twigs are represented by known groups of organisms; while their primordial kinship would be expressed by the trunk or common parent stock. In order to complete our sketch of evolution, we should have to delineate the probable future of the universe at large, and of the highly developed organisms which will in the far-distant future in all probability be produced. Mr. Herbert Spencer, in his 'First Principles,' points out that the knowledge of any object, or group of objects, is not complete until we can express its past and its probable future history.

Such knowledge we do possess of all existences, and science has extended, and will continue further to extend it. For instance, we know that a man has passed through the stages of infancy, childhood, and youth, and we can predict that he will at some time die, and that his body will decay. To the biography of the individual man, science adds a biography, beginning with a small aggregate of no appreciable structure, presenting no marked differentiation of parts, and ending with the various products of decomposition. These two processes of growth and decay are to be distinguished as evolution and dissolution, and the universe as a whole, together with every minutest portion of it, exhibits processes which come under these two categories. May we not infer that philosophy has to formulate such changes? There are many complex factors to be distinguished as taking part in these processes: hence arises great difficulty in tracing out transformations so vast, so varied, and so intricate. In considering all natural processes we are driven to the conclusion that increase in complexity is always accompanied by increase in integration. As an instance of this may be cited the fact that the mural decorations of the Egyptians and Assyrians, as also Bushman paintings, when contrasted with modern pictures, show little or no combination or connection of parts, while now the success with which unity of effect is deduced from variety of components is a chief test of merit. And so also with language and music. A good novel, a good sermon, a good lecture, or a good musical composition may be said invariably to contain and exemplify some leading idea, some characteristic conception or trait. Evolution may be defined as a change from an indefinite, incoherent homogeneity, to a definite coherent heterogeneity, accompanying the dissipation of motion and the integration of matter. Of course, in interpreting evolution we should have to consider the various resolutions of force which accompany the primary and secondary redistributions of matter and motion. The question arises, will these changes go on for ever? There are two possible hypotheses to be distinguished, respecting the origin of the multitudinous kinds of organisms which exist and have existed. Either they have been from time to time separately made, or they have arisen by insensible steps through actions such as we see continually going on. But while the hypothesis of special creation is discredited by its association with early views in general, that of evolution is credited by its association with the latest results of modern thought, and while the former theory implies that the imperfections of an

imperfect system were specially designed, the latter belief does not carry with it such manifestly contradictory implications. Again, unity of plan is a higher mark of perfection than diversity of operation. Finally, while the hypothesis of special creation cannot be framed into a coherent thought, since it manifestly involves either a creation of matter or a creation of force, both of which are entirely inconceivable, the evolution theory is a symbolic conception more or less completely realizable in thought. A single cell under appropriate conditions becomes a man in the space of a few years; can we not imagine, then, that under favorable conditions a cell might, in the course of untold millions of years, have given origin to the human race? Moreover, direct evidence, overwhelming in its character, may be adduced from the known facts of classification, embryology, morphology, palæontology, and distribution in space. Though, then, we must accept the theory of evolution as an established induction, we should be careful always to consider it as nothing more than a method of procedure pursued by an Almighty Designer, to whose power and wisdom no limits either in space or in time can be imagined. Though life's problems are in their essence inscrutable, still we can with justice refer all things to the working of a Supreme Power; and though on the hypothesis of evolution, the conception of utilitarianism as egoistic hedonism, so despicable when thus understood, may be shown to fail most lamentably when regarded as a guide to the facilitation of the gradual change we are undergoing, that of altruistic hedonism as enunciated by Christ will, if fully and truly recognised as the final basis of morality, tend to an increase in the rapidity of the advance by which we hope to progress towards a better and more perfect state.

